THE UNIVERSITY OF ALBERTA

AN EVALUATION OF INTER-TEMPORAL PRICE RELATIONSHIPS IN THE WINNIPEG RAPESEED FUTURES MARKET

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

SPRING, 1976

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Evaluation of Inter-Temporal Price Relationships in the Winnipeg Rapeseed Futures Market" submitted by Colin Andre Carter in partial fulfilment of the requirements for the degree of Master of Science.

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ABSTRACT

In western Canada the prices discovered in the rapeseed futures market are used as a basis for determining prices received by producers at their local elevators. The producer prices are arrived at under the assumption that the price generated in the futures market tends to be an unbiased estimate of the spot price to prevail upon expiry of the futures contract. That is, the street pricing committees have assumed that Working's "Theory of the Price of Storage" correctly represents inter-temporal price relationships in the Winnipeg rapeseed futures market. If this assumption proves incorrect, however, and if Keynes' "Theory of Normal Backwardation" describes the inter-temporal price relationships with more accuracy and regularity, then there results serious implications to producer street prices.

The objective of this thesis is to evaluate inter-temporal price relationships in the Winnipeg rapeseed futures market. The methodology used in the analysis attempts to determine whether or not the prices discovered in the Winnipeg rapeseed futures market can be taken as being reliable estimates of the spot price prevailing on the date of expiry of the futures contract. That is, it tests a major implication of Keynes' theory: that there is an upward trend in futures prices, relative to spot prices, as the futures contract

approaches maturity. This test for any price bias is more explicit than one used in a previous Canadian study by Martin and Storey and it provides a more detailed breakdown of the extent of the bias believed to exist.

In addition to estimating the degree of price bias in the Winnipeg rapeseed futures market, this study also presents the coefficients of determination between the first differences of each futures price and the first differences of each spot price for the period studied. If risk reduction is a major objective of hedgers, the usefulness to them of futures markets depends on the degree of correlation that exists between movements in cash prices and movements in futures prices and the higher the correlation the more attractive both long and short hedging become. The results suggest that both long and short hedgers should prefer to hedge on near futures contracts rather than on more distant futures contracts, and provided other determining factors remain constant, they should tend to prefer to hedge on the November Thunder Bay and September and November Vancouver contracts.

It was found that rapeseed futures prices determined in the Winnipeg market tend to be downward biased in their estimate of forthcoming spot prices. The price biases displayed by the various Vancouver contracts range from 1.1 to 21.86 percent per annum and those for the various Thunder Bay

contracts from 2.85 to 35.86 percent per annum. The degree of price bias tends to be the largest for those contracts that are likely subject to the greatest amount of short hedging pressure and these are those contracts which mature immediately succeeding the harvest. Since producer prices tend to be a reflection of futures prices, they too tend to be downward biased to the same extent as the futures contract on which they are based. By detailing the extent to which each particular rapeseed futures contract traded in Winnipeg tends to be downward biased, the results provide sufficient information to allow the street pricing committees, or their possible successors, to make a reasonable adjustment to street prices to correct for the price bias.

ACKNOWLEDGEMENTS

I would like to thank my parents for their encouragement and support and Dr. M.M. Veeman for her guidance.

Financial assistance for this study was supplied by the Alberta Agricultural Research Trust.

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CHAPTER I

INTRODUCTION

Purpose of the Study

The theory of inter-temporal price relationships, advanced by Holbrook Working,[1] views futures prices as being reliable estimates of the cash or spot price to prevail on the date of expiry of the futures contract. In his view, relations between prices for delivery at different dates are determined by the "cost" of carrying stocks. An earlier theory, propounded by John Maynard Keynes,[2] views futures prices as being unreliable estimates of the cash or spot price prevailing on the date of expiry of the futures contract. He believed it "normal" for the futures price to be a downward biased estimate of the forthcoming spot price.

The purpose of this study is to determine which theory, that advanced by Working or Keynes, best represents inter-temporal price relationships in the Winnipeg rapeseed futures market. The study tests for any evidence of price bias in

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[1] H. Working, "Theory of the Price of Storage", American Economic Review, Vol. XXXIX, No. 6 (1949), pp. 150-66.

[2] J.M. Keynes, Treatise on Money, Vol. II (New York: Harcourt Publishers, 1930), p. 143.

the Winnipeg market. That is, it is designed to determine whether or not rapeseed futures prices can be taken as being reliable estimates of the spot price to prevail on the date of expiry of the futures contract.

The Problem

The prices discovered in the rapeseed futures market on the Winnipeg Commodity Exchange are used as a basis for determining producer (street) prices in Canada. It appears that the street prices are arrived at under the assumption that the price generated in the futures market tends to be an unbiased estimate of the spot price to prevail upon expiry of the futures contract. Martin and Storey[3] have pointed out the implication to producer prices of a price bias in the futures market. Their study concluded that if the rapeseed futures price is a biased estimate of the forthcoming spot price, then prices received by producers are also biased, to the extent that they are a reflection of biased futures prices.

This study is an investigation of a problem: the implication of downward biased futures prices to producer street prices.

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[3] L. Martin and G. Storey, "Temporal Price Relationships in the Vancouver Rapeseed Futures Market and Their Implication to Farm Prices", Canadian Journal of Agricultural Economics, Vol. 23, No. 3 (November, 1975), pp. 1-12.

Scope and Methodology

The scope of this study encompasses an analysis of rapeseed cash and futures prices from 1963 to 1975 for Vancouver and Thunder Bay contracts traded on the Winnipeg Commodity Exchange.

The technique employed to test for any evidence of price bias in the rapeseed futures market is drawn from a previous study by H.S. Houthakker,[4] who analyzed inter-temporal price relationships for cotton and corn futures in the United States. His methodology assesses futures price changes over time, adjusted for any change in spot prices. That is, it tests a major implication of the Keynes theory of "normal backwardation", that there is an upward trend in futures prices, relative to spot prices, as the futures contract approaches maturity.

The Plan of the Study

The first chapter briefly sketches the purpose of the study, the problem, and the methodology used in the analysis.

Chapter II provides background information for the study in that it describes features of the production and marketing of rapeseed in Canada. Information on the extent

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[4] H.S. Houthakker, "Commodity Futures IV: An Empirical Test of the Theory of Normal Backwardation", (Cowles Commission Discussion Paper; Economics No. 2124, June 22, 1955).

of production, the type of markets, and selected functions of marketing is presented in this chapter.

Chapter III comprises a review of relevant literature. This chapter concentrates on the two widely accepted theories on inter-temporal price relationships in futures markets.

Chapter IV sketches the general theory of the operations of a futures market. This chapter also includes a description of the contract for Winnipeg rapeseed futures and details of the formation of rapeseed street prices in Western Canada.

Chapter V presents a statistical analysis of cash and futures prices. The analysis attempts to determine whether or not the theory of "normal backwardation" is representative of the rapeseed futures market in Winnipeg. As in the case of the Martin and Storey study, a significant downward price bias in the Winnipeg rapeseed futures market is also found by this study. An extension of the Martin and Storey study is made by the use of a more explicit test in measuring for a price bias. The model, with results, and a discussion of the implications and conclusions complete the chapter.

The final chapter, Chapter VI, provides a summary of conclusions from the study and presents a number of recommendations.

CHAPTER II

THE PRODUCTION AND MARKETING OF RAPESEED IN CANADA

Early History of the Oilseed

The exact origin and history of the type of rapeseed grown in Canada is vague. Rapeseed is a member of the Cruciferae family which includes cabbage, cauliflower, turnip, and mustard plants. The word rape is derived from the Latin word rapum, meaning turnip. According to Sanskrit writings the crop was likely first cultivated in India as long ago as 2,000 B.C. and records suggest it was introduced to Japan from China about 35 B.C. The production of rapeseed was substantial in Europe from the thirteenth to the seventeenth century but then it suddenly subsided, not to be reintroduced until the twentieth century.[1]

The Adoption and Production of Rapeseed in Canada

The production of rapeseed was commercially initiated in Canada in 1942 or 1943 with a handful of western farmers sowing Argentine species. The results suggested the crop

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[1] Canadian International Grains Institute, Grains and Oilseeds, 2nd ed. (Winnipeg: Canadian International Grains Institute, 1975), p. 609.

might be well adapted to Canadian conditions. However, since the production of the oilseed was introduced primarily to provide a source of lubricating oil for marine and aircraft engines during the war, its production virtually ceased following the war.

Table 2.1 documents the extent of acreage, yield, production, and farm price of rapeseed since its adoption in Canada and gives some indication of the rate of adoption. This has been most rapid in the past fifteen years.

Figure 2.1 illustrates the levels of production, stocks, exports and domestic consumption of rapeseed from 1964 to 1975. One can infer from Figure 2.1 that in the past few years rapeseed has gained ground as one of Canada's major crops. Production of rapeseed did not attain a respectable position as a major crop on the Canadian prairies until 1955 when the planted acreage reached 138,000 acres which netted 1,588,200 bushels (36,000 metric tons) of rapeseed. Ten years later the planted acreage reached 1,435,000 acres and produced 22,800,000 bushels (517,000 metric tons). Twenty years later, Canadian farmers planted 3,160,000 acres which yielded 51,300,000 bushels (1,163,000 metric tons).

The relatively recent popularity of this oilseed can be attributed to the fact that it is a cash crop which typically realizes returns equal to or better than the conventional crops of wheat, barley, and oats; the early maturing varieties allow extension of the busy seeding and harvest seasons; it is a good source of vegetable oil; and, as a

TABLE 2.1

RAPESEED ACREAGE - YIELD PER ACRE - PRODUCTION - AVERAGE FARM PRICE

1943/44 TO 1975/76

Crop Year	Acreage	Yield Per Acre (bu.)	Production (bu.)	Average Farm Price ($ per bu.)
1943-44	3,200	13.9	44,400	--
1944-45	10,800	11.3	122,400	--
1945-46	12,500	13.4	168,000	--
1946-47	23,500	11.0	259,400	--
1947-48	58,300	7.5	438,000	--
1948-49	80,000	16.0	1,280,000	--
1949-50	20,000	17.0	340,000	$2.50
1950-51	400	6.0	2,400	$1.90
1951-52	6,500	18.5	120,000	$1.75
1952-53	18,500	15.0	278,000	$1.70
1953-54	29,500	16.6	491,000	$1.80
1954-55	40,000	14.4	578,000	$1.65
1955-56	138,000	11.3	1,558,200	$1.75
1956-57	351,900	17.0	5,996,400	$1.75
1957-58	617,500	14.0	8,661,160	$1.60
1958-59	626,000	12.4	7,762,000	$1.25
1959-60	213,500	16.7	3,560,000	$2.00
1960-61	763,000	14.6	11,120,000	$1.65

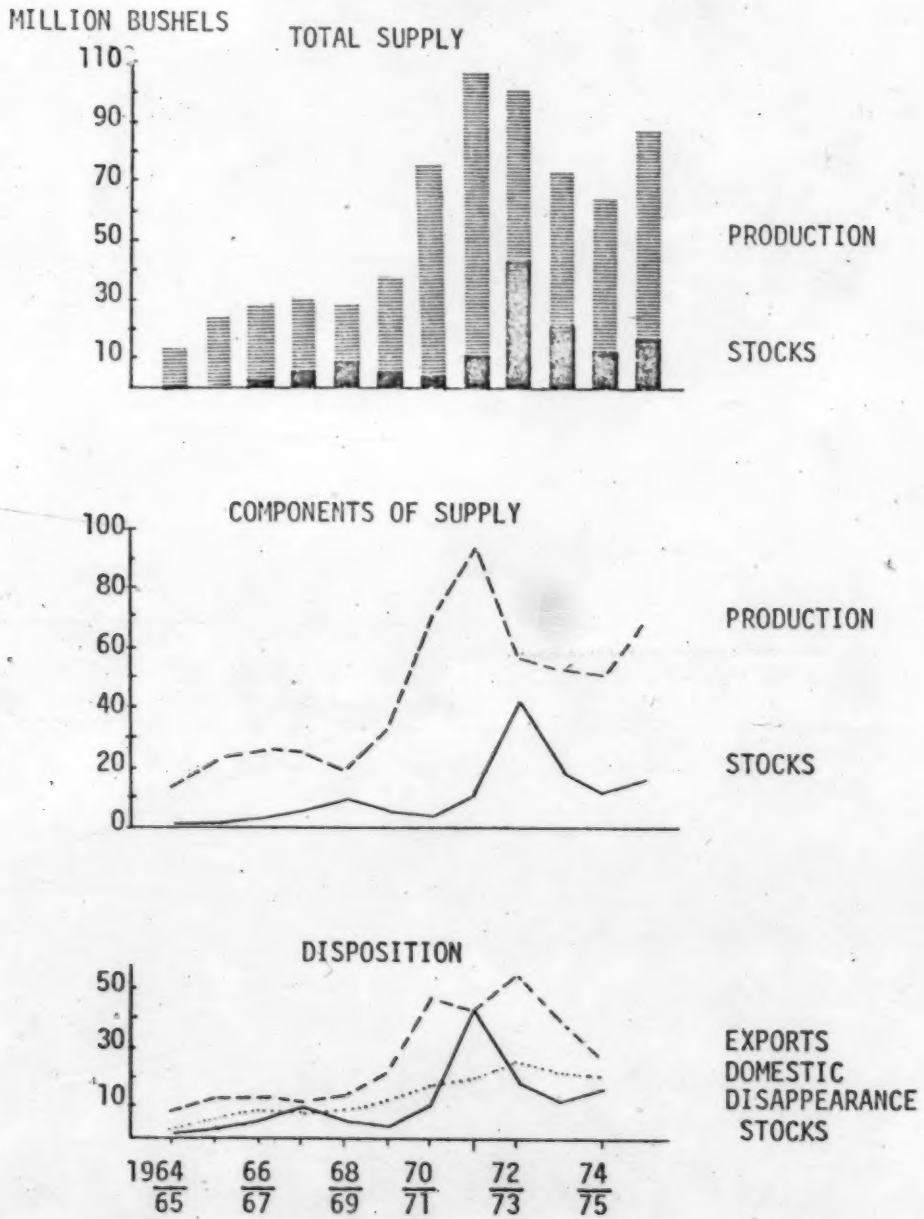
TABLE 2.1 (CONTINUED)

Crop Year	Acreage	Yield Per Acre (bu.)	Production (bu.)	Average Farm Price ($ per bu.)
1961-62	710,300	15.8	11,220,000	$1.80
1962-63	371,200	15.8	5,860,000	$2.05
1963-64	478,000	17.5	8,360,000	$2.50
1964-65	791,000	16.7	13,200,000	$2.54
1965-66	1,435,000	15.9	22,600,000	$2.33
1966-67	1,525,000	16.9	25,800,000	$2.46
1967-68	1,726,000	15.4	24,700,000	$1.92
1968-69	1,050,000	18.5	19,400,000	$1.83
1969-70	2,012,000	16.6	33,400,000	$2.29
1970-71	4,050,000	17.8	72,200,000	$2.33
1971-72	5,306,000	17.9	95,000,000	$2.16
1972-73	3,270,000	17.5	57,300,000	$3.16
1973-74	3,150,000	16.9	53,200,000	$8.72
1974-75	3,160,000	16.2	51,300,000	--
1975-76 (est.)	4,020,000	17.8	71,556,000	--

SOURCE: Statistics Canada, Cat. No. 22-006; Cat. No. 21-003.

FIGURE 2.1

RAPESEED - SUPPLY AND DISPOSITION - CANADA 1964-65 TO 1975-76



SOURCE: Agriculture Canada, Grains and Oilseeds (Ottawa: Queen's Printer, 1975), p. 34.

byproduct, it provides a high protein meal suitable for livestock feeding.

Figure 2.2 outlines the areas of production of rapeseed in Canada. Rapeseed is a cool season crop and can be grown on a wide range of soil varieties, with loamy soils being preferred. Light and peaty soils will also produce reasonable crops provided there is adequate rainfall and fertility. In drier areas it is recommended that seeding be restricted to the heavier soils such as clays or clay loams.

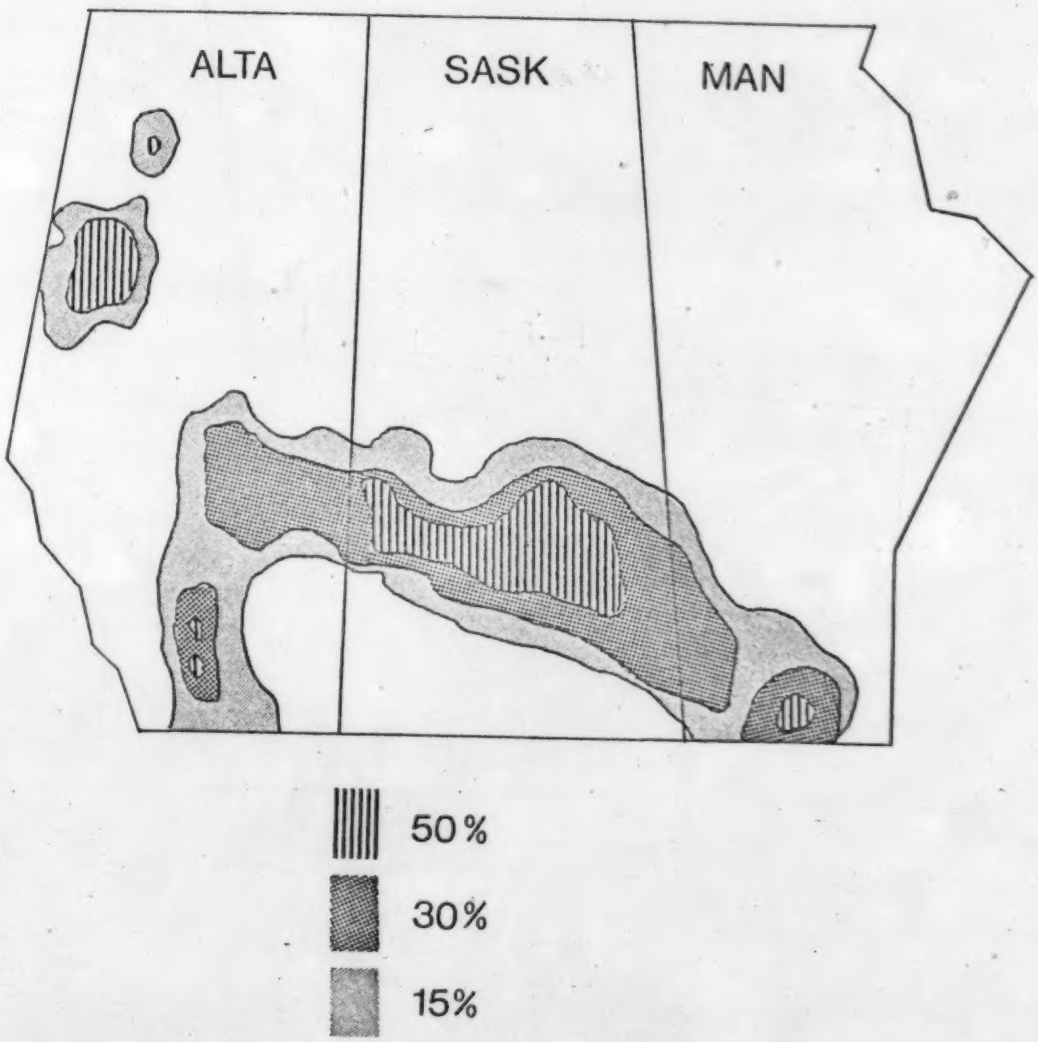
The two species of rapeseed that are grown in western Canada are a summer rape, Brassica napus L., and a summer turnip rape, Brassica campestris L. These are more commonly referred to as Argentine and Polish types respectively. Of the two species, varieties of the Argentine type have a greater potential yield than those of the Polish type but varieties of the latter are generally preferred in Canada because they take fewer days to mature. Tables 2.2 and 2.3 compare and contrast characteristics and agronomic performance of these two species. Table 2.4 indicates the extent to which each variety is grown in Canada.

Markets for Canadian Rapeseed

In the domestic and international market, rapeseed oil is forced to compete with cottonseed oil, soyabean oil, peanut (ground nut) oil, sunflowerseed oil, safflowerseed oil, seasameseed oil, olive oil, and corn oil. Because of similari-

FIGURE 2.2

RAPESEED GROWING AREA OF THE PRAIRIE PROVINCES OF CANADA



SOURCE: Canadian International Grains Institute, Grains and Oilseeds, 2nd ed. (Winnipeg: Canadian International Grains Institute, 1975), p. 614.

TABLE 2.2

CHARACTERISTICS OF RAPESEED SPECIES GROWN IN CANADA

Characteristics	B. napus	B. campestris
Common Name	Argentine type	Turnip rape
Days to Mature	Equal to wheat	14-21 days earlier
Height (meters)	0.8 - 1.2	0.5 - 0.9
Yield Potential	High in moist, frost free areas	15-20% lower when no frost or drought
Seed Color	Brown to black	Reddish brown
Seed Size (g/1,000)	4.0	2.5
Mode of Pollination	70% selfed	95% cross-pollinated
Varieties (low E[a]	Midas, Zephyr, Oro	Torch, Span
(low E + G[b]	Tower	-----
(normal E	Turret, Target	Echo, Polar, Arlo

a. E = erucic acid in the oil.

b. G = glucosinolate in the seed meal.

SOURCE: Rapeseed Association of Canada, Proceedings of Eighth Annual Meeting (Mexico City, Mexico, 1975), p. 67.

TABLE 2.3

AGRONOMIC PERFORMANCE OF RAPESEED VARIETIES IN WESTERN CANADA, 1973-74

Species and Variety	Yield cwt/acre	% Oil	% Protein	Days to Mature	Height (inches)
B. napus					
Midas	17.4	42.7	39.3	103	38
Tower	16.3	41.1	45.1	102	38
Zephyr	15.8	39.6	40.7	105	42
Target	16.1	42.7	42.7	104	38
B. campestris					
Torch	14.1	38.5	40.4	87	33
Span	13.7	38.0	40.2	87	33
Echo	14.2	39.4	41.4	88	35

SOURCE: Rapeseed Association of Canada, Proceedings of Eighth Annual Meeting (Mexico City, Mexico, 1975), p. 67.

TABLE 2.4

RAPESEED VARIETIES GROWN IN WESTERN CANADA (1974)

B. napus			B. campestris		
Variety	'000 Acres	%	Variety	'000 Acres	%
Midas	641	20	Torch	1012	32
Tower	62	2	Span	1032	32
Oro	75	2	High E	139	4
Zephyr	181	6			
High E	60	2			

SOURCE: Agriculture Canada, Food Systems Branch, Oilseeds in Canada (Ottawa: Queen's Printer, 1975).

ties in fatty-acid make-up related to physical properties and flavour stability, rapeseed oils tend to compete most directly with soyabean oil in the edible oils category.

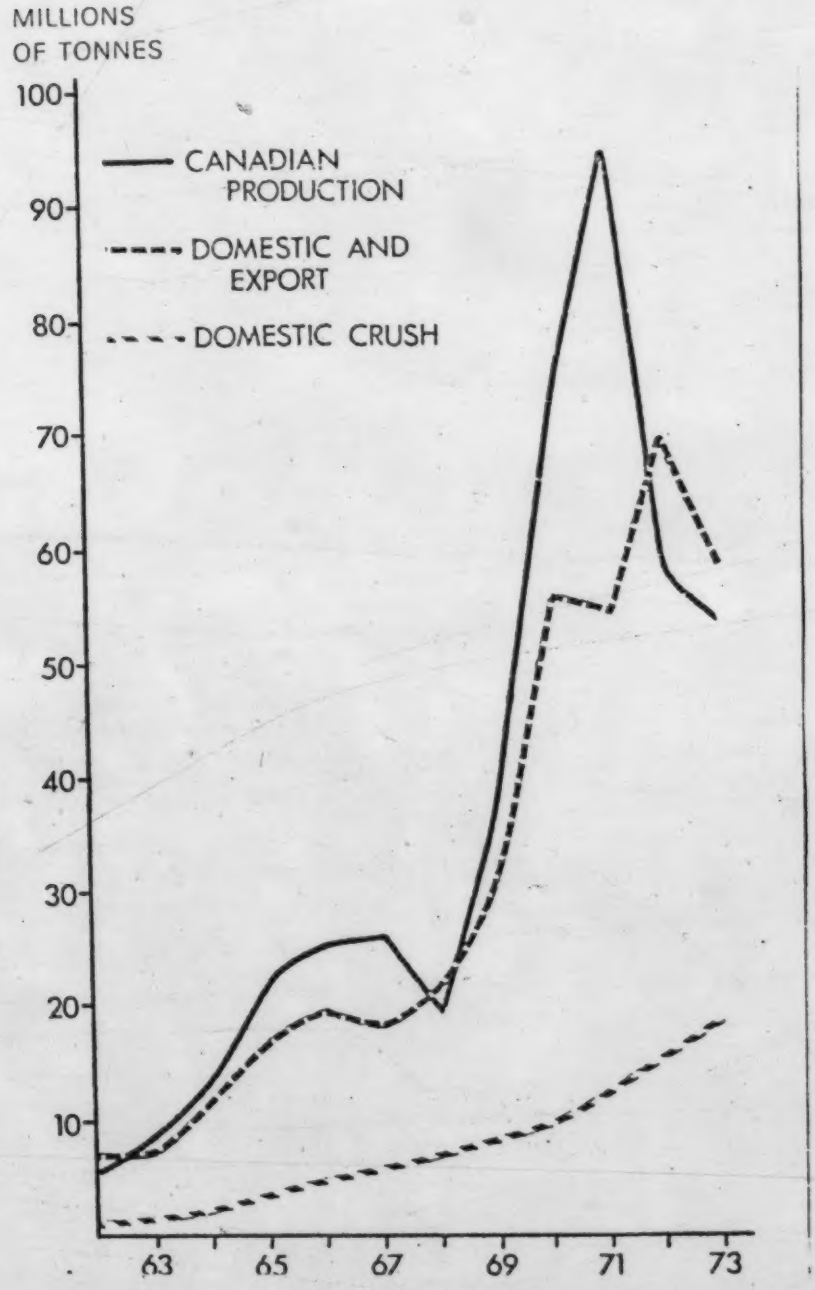
Although Canada is not the world's largest producer of rapeseed, it remains the major rapeseed supplier to the world market (refer to Table 2.5). Table 2.6 documents the extent of past export demand for Canadian rapeseed.

As evidenced in Table 2.7, domestic rapeseed oil usage has increased to the point where Canadians consume rapeseed oil in larger quantities than any other edible oil. Close to forty percent of the vegetable oil used in Canada is constituted by rapeseed oil, the major product derived from rapeseed. Table 2.8 provides a breakdown of the utilization of the oil. An important secondary product, rapeseed meal, represents over 60% of the original weight of rapeseed when processed and the bulk of this is sold to the feed trade. The extent of domestic consumption of the meal is documented in Table 2.9.

Table 2.10 and Figure 2.3 give an indication of the importance of domestic crushing plants as a market for the Canadian rapeseed crop. This source of demand has increased dramatically in the past fifteen years. Rapeseed oil was first extracted in Canada for edible purposes in 1957. Since 1957, the crushing industry in Canada has expanded rapidly, reaching a capacity of twenty million bushels per year (453,597 metric tons) in 1974. The industry is continuing to expand at an increasing rate and projections for the

FIGURE 2.3

CANADIAN RAPESEED PRODUCTION, DOMESTIC CRUSH AND DISAPPEARANCE, 1962-1973



SOURCE: Canadian International Grains Institute, Grains and Oilseeds, 2nd ed. (Winnipeg: Canadian International Grains Institute, 1975), p. 622.

TABLE 2.5

AVERAGE ANNUAL RAPESEED PRODUCTION AND NET EXPORTS OF MAJOR PRODUCING AREAS, 1970-73

Producing Areas	'000 Metric Tons	
	Production	Exports
Canada	1,575	1,066
Indian Sub-continent	2,812	0
China	1,202	160
Western Europe	1,285	552
Eastern Europe	1,102	332
All Others	468	47

SOURCE: Rapeseed Association of Canada, Proceedings of Eighth Annual Meeting, (Mexico City, Mexico, 1975), p. 67.

TABLE 2.6

EXPORTS OF CANADIAN RAPESEED BY DESTINATION (in thousand bushels)

Destination	Average 1965-69	1970	1971	1972	1973	1974
			'000 Bushels			
E.E.C. (9)	3,167	8,836	24,878	15,438	11,585	2,044
Japan	8,733	14,829	19,054	25,935	31,349	21,779
Eastern Europe[a]	201	872	573	--	--	0
Taiwan	555	--	--	--	795	--
India	--	643	3,540	2,259	2,262	199
Pakistan[b]	339	1,289	936	2,295	3,574	744
Mexico	--	554	--	2	1,034	1,708
Other Countries	500	1,007	1,773	1,594	2,033	656
Total	13,495	28,030	50,754	47,523	52,632	27,160

a. Excluding U.S.S.R.

b. Including Bangladesh.

SOURCE: Agriculture Canada, Canada's Trade in Agricultural Products 1973 and 1974, (Ottawa: Queen's Printer, 1975), p. 64.

TABLE 2.7

AVERAGE ANNUAL PERCENT AND PER CAPITA VEGETABLE OIL USAGE IN CANADA, 1972-74

	Consumption	
Vegetable Oil	%	kg./Capita
Rapeseed	38	4.5
Soyabean	34	4.0
Palm	7	0.8
Coconut	6	0.7
Corn	5	0.5
Sunflower	4	0.5
Cotton	2	0.3
Peanut	2	0.3
Palm Kernel	2	0.3
Total All Vegetable Oils	100	11.9

SOURCE: Rapeseed Association of Canada, Proceedings of Eighth Annual Meeting, (Mexico City, Mexico, 1975), p. 67.

TABLE 2.8

CANADIAN UTILIZATION OF DEODORIZED RAPESEED OIL

Year	Oil (Thousands of Pounds)			
	Margarine Oil	Shortening Oil	Salad Oil	Total
1967	36,200	38,700	26,900	101,700
1968	32,800	46,000	37,900	116,700
1969	41,674	48,853	45,008	135,535
1970	41,354	43,465	45,478	130,296
1971	47,298	60,724	52,455	160,477
1972	68,578	73,968	69,482	212,027
1973	75,824	89,269	72,593	237,686
1974 (est.)	62,415	67,609	74,639	204,663

SOURCE: Rapeseed Association of Canada, Proceedings of Eighth Annual Meeting (Mexico City, Mexico, 1975), p. 21

TABLE 2.9

CANADIAN UTILIZATION OF RAPESEED MEAL, METRIC TONS

Year	Metric Tons of Meal
1966	42,456
1967	49,115
1968	53,881
1969	79,342
1970	88,993
1971	92,708
1972	156,592
1973 (est.)	178,737
1974 (est.)	163,175

SOURCE: Rapeseed Association of Canada, Proceedings of Eighth Annual Meeting (Mexico City, Mexico, 1975), p. 22.

TABLE 2.10

RAPESEED CRUSHINGS IN CANADA, CROP YEARS 1961 TO 1975

Crop Year	Bushels Crushed	Percentage of Crop Crushed	Pounds of Oil Produced	Tons of Oil Meal Produced
1960-61	959,803	8.1	--	--
1961-62	1,313,750	10.7	--	--
1962-63	1,615,841	27.4	30,800,116	24,094
1963-64	1,574,065	18.2	30,759,353	23,199
1964-65	2,156,419	16.1	42,430,605	31,465
1965-66	3,745,507	16.5	73,384,109	54,017
1966-67	4,963,009	19.0	99,366,504	70,838
1967-68	5,159,104	20.9	103,470,711	74,175
1968-69	6,993,822	35.1	140,543,142	98,207
1969-70	7,760,990	23.0	153,042,127	114,232
1970-71	8,575,200	11.0	169,891,732	124,381
1971-72	12,539,986	13.5	234,285,936	179,265
1972-73	15,608,410	27.2	295,342,344	225,056
1973-74	14,268,160	26.7	276,967,788	213,772
1974-75	12,168,202	--	243,343,321	171,813

SOURCE: Statistics Canada, Cat. No. 22-006.

end of 1976 place the Canadian crushing capacity at approximately fifty million bushels (1,133,922 metric tons).

Canadian Institutions and the Marketing of Rapeseed

Five important functions of marketing are: price discovery; standardization and grading; transportation; storage; and the provision and dissemination of information and research. Concentrating on the latter four, this section[2] briefly outlines existing Canadian institutions which provide the above functions for the marketing of rapeseed.

In Canada, rapeseed is marketed through the open market system, in contrast to domestic cereals which are marketed through a single statutory purchasing and sale organization, the Canadian Wheat Board. Alternatives to the open market system would involve sale through the Canadian Wheat Board, a system of voluntary pooling for an average price, or sale through a producer marketing agency.

1. Price Discovery

In theory, the price of rapeseed in an open market system is discovered freely through the demand/supply process established in an open market. The market through which Canadian rapeseed is exchanged is the Winnipeg Commodity Exchange, which, with the provision of the futures market,

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[2] The bulk of the information in this section is drawn from a previous study; see, Rapeseed Marketing Committee, Rapeseed Marketing (Ottawa, 1971).

should in theory provide a system of price protection by providing a facility for hedging for buyers and sellers of the commodity. In theory the existence of a well-functioning futures market should also yield futures prices which serve as an indicator of the market price up to nine months in advance. The open market system is also generally believed to promote efficiencies by way of promotion of competition throughout the marketing infrastructure. In practice however, the open market system for rapeseed in Canada diverges from a pure open market system. "Rather, the system represents the surviving features of the open market system as the various participants have responded to the environmental changes of more governmental control and an imperfect world market place."[3]

Further discussion on the operation of the Canadian rapeseed futures market is to follow in Chapter IV. Chapter IV will also outline the method of street pricing in Western Canada, where street prices are based on the prices of futures contracts.

2. Standardization and Grading

Grading is very important to the marketing process. Standardization makes buying and selling by sample or by description alone possible. As well, standardization and

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[3] Rapeseed Marketing Committee, Rapeseed Marketing (Ottawa, 1971), p. 31.

the practice of grading make economies of scale in transportation and storage possible.

Almost all of the buying and selling of Canadian rapeseed is done on the basis of government grading. When the Canada Grain Act was passed in 1912, the federal government appointed a Board of Grain Commissioners and charged it with the responsibility for regulating all phases of the handling of grain in Canada, including grading. The Board has its headquarters in Winnipeg and provides general supervision over the standardization and grading of Canadian rapeseed.

The Commissioners have offices in seventeen centers across Canada, with a total staff of approximately one thousand. The Executive Office is responsible for co-ordinating and implementing policies and decisions of the Board. A committee of the Board on Western and Eastern Grain Standards meets annually to name and define commercial grades and to set the minimum standards of each. The Board is mainly financed by fees collected for services rendered.

The inspection division has staff located in seven points in the East and twelve in the West. In the West, as a basis for settlement on grades, a free inspection service is provided on rapeseed delivered into country elevators. At the primary inspection points of Winnipeg, Calgary, and Edmonton the division procures and samples rapeseed en route to market. Also, all rape received and discharged from terminal elevators is sampled and inspected. The inspection division annually prepares tentative standard and standard

export samples for the Committee on Grain Standards.

Responsibility for monitoring the weighing of all rapeseed received at and shipped from licensed terminal elevators lies with the grain weighing division. This division investigates and reports to the Board on complaints of shortages or overages in carlot or vessel shipments of rapeseed. As well, the division inspects, tests, and certifies scales and associated handling equipment.

The operation and maintenance of the Canadian Government Elevators system falls within the duties of the Board of Grain Commissioners. There are five terminal elevators at interior points in the prairie provinces and one in Prince Rupert, B.C. The interior elevators are used mainly for cleaning and storing rapeseed and other grains.

The country elevator agent is the first to implement the grading system; this is done when a farmer makes a delivery to the elevator. The agent takes a sample from the rapeseed delivered, determines the percentage of dockage in the sample, and then grades the cleaned seed. If a farmer is dissatisfied with the grade and dockage offered by the agent he may arrange to send a sample to the nearest government inspection office for grading. If still not satisfied, the complaining party can appeal to the Grain Appeal Tribunal constituted by the Board, whose decision is final.

The rapeseed is loaded into a boxcar at the country elevator and the agent places a bag containing a sample of it inside the door of the car. While the seed is en route

to a terminal elevator, the local government inspection office removes this sample, determines its dockage and grades it. Before the boxcar reaches the terminal elevator to which it is consigned, the elevator is notified of the grading results. Only when the car is unloaded, does a government inspector take an official sample and grade it. Shipments out of the terminal are also officially sampled. When the grade of a shipment out of a terminal elevator has been established, the Board of Grain Commissioners issues a "certificate Final", which is a guarantee to the buyer of the rapeseed, of its quality.

A schedule of statuatory grades for rapeseed adopted by the Canadian government is shown in Table 2.11.

3. Transportation

All rapeseed in Canada is grown in the prairie provinces and most of it must be transported a considerable distance to domestic and foreign markets. Therefore the co-ordination and efficiency of the transportation network is important to the marketing of the oilseed.

The marketing of rapeseed involves truck hauling to local country elevators and inland terminals, rail haul to export and domestic destinations, and ocean shipping to foreign destinations.

Under the Crow's Nest Pass agreement, rapeseed rail rates are determined by statute for export shipments and for domestic shipments to Thunder Bay. Other domestic rates are

TABLE 2.11

STATUTORY GRADES

Grade name	Standard of Quality		Standard of cleanness (See note)
	Minimum weight per measured bushels in pounds	Degree of soundness	
No. 1 Canada Rapeseed	52	Reasonably sound; cool and sweet; may contain not over 3% damaged seeds, including not over 0.1% heated. Of good natural colour.	May contain not more than 1% of other seeds that are conspicuous and that are not readily separable from Rapeseed, to be assessed as dockage.
No. 2 Canada Rapeseed	50	Cool and sweet; may contain not over 10% damaged seeds, including not over 0.2% heated.	May contain not more than 1.5% of other seeds that are conspicuous and that are not readily separable from Rapeseed, to be assessed as dockage.
No. 3 Canada Rapeseed	48	May contain not over 20% damaged seeds, including not over 0.5% heated. May have the natural odour associated with low quality seed, but shall not be distinctly sour, musty, rancid, nor have any odour that would indicate serious deterioration or contamination.	May contain not more than 2% of other seeds that are conspicuous and that are not readily separable from Rapeseed, to be assessed as dockage.

NOTE: Assignment of rapeseed to any of the above grades shall not imply any guarantee with respect to content of other seeds that blend with rapeseed.

The percentage of "other seeds that are conspicuous and that are not readily separable" shall include weed seeds that do not blend with rapeseed and whole or broken kernels of other grains, when these are not removeable by means of appropriate sieves and other cleaning devices.

Dockage shall be assessed on rapeseed for foreign material that is readily separated from the mass by ordinary mechanical cleaning methods, including any small whole or broken rapeseed that is removed along with such foreign material, plus any other seeds, up to the limits established in the respective grades, that are conspicuous and that remain in samples after ordinary mechanical cleaning methods have been applied, these to be added together and expressed as a percentage by weight of the whole; except that a reasonable allowance may be made for broken rapeseed not to be assessed as dockage in commercially clean rapeseed when this can be attributed to attrition in the normal handling after cleaning.

SOURCE: Searle Grain Company Limited, Rapeseed Production in Western Canada, (Winnipeg: Searle Grain Company Limited, 1966), p. 18.

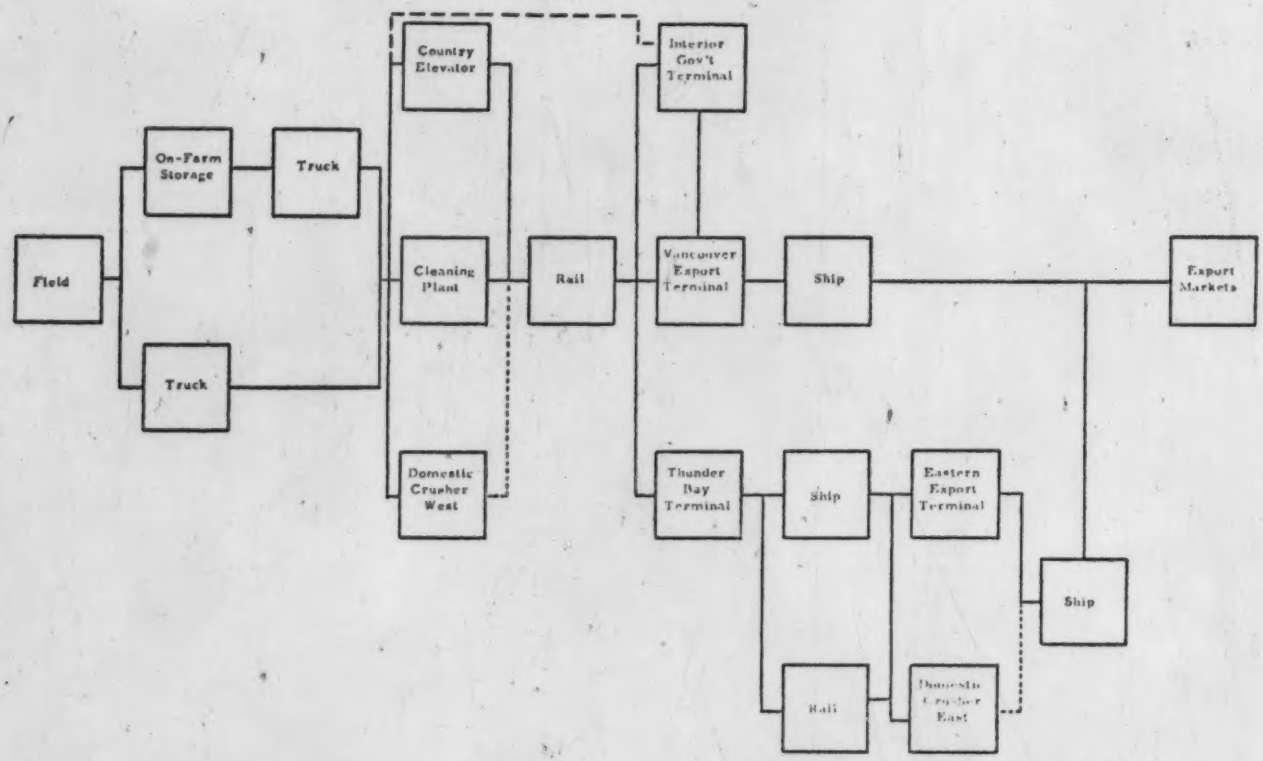
supervised by the Canadian Transport Commission. Because rail rates are thus restricted, trucking is generally not competitive with rail carriage to Vancouver. However, if the Crow's Nest rates were to be abolished, as has at times been speculated, the trucking of rapeseed to ports in Vancouver would likely become competitive with rail transportation and might even, in the presence of economies of scale, prove to be less costly.

The physical flow of rapeseed from the field in western Canada to market is depicted in Figure 2.4. The producer generally controls the transportation of rapeseed to interior delivery points. Rapeseed then either continues through the elevator system, to a cleaning plant, or to a domestic crusher. About three-fourths of rapeseed grown in Canada is marketed through the country elevator system. The local elevator agent buys rapeseed from the producer, grades it and loads it into boxcars. Co-ordination of rail shipments is provided by the Canadian Wheat Board under the "block system". Loaded boxcars are gathered from country elevators and hauled to main lines where they are made up into unit trains consisting of upwards of one hundred cars.

Most of the rapeseed bound for export moves through the ports in Vancouver, placing a great stress on the facilities there. However, the extent of movement through Thunder Bay is increasing relative to Vancouver. This tendency is expected to continue. The ports of Quebec City and Baie-Comeau handle a significant amount of rapeseed in Eastern

FIGURE 2.4

PHYSICAL MOVEMENT OF RAPESEED FROM FARM TO MARKET



SOURCE: Rapeseed Marketing Committee, Rapeseed Marketing (Ottawa: 1971), p. 21.

Canada.

4. Storage

Under the Canada Grain Act, a producer has the right to obtain storage of his rapeseed upon delivery of it to a country elevator. The elevator operator has the obligation to accept the rapeseed if he has available storage accommodation for the variety and grade in question. He is responsible for the rapeseed while in his care and must see that it does not suffer deterioration in storage due to such factors as insect infestation or heating.

Unless delivered for storage in a special bin, different loads of rapeseed of the same grade are binned together in the country elevator. This allows the operator to conserve space. As the identity of the different lots is lost, the holder of the graded storage ticket is not entitled to the return of his own seed but only to the return of seed of the same grade and weight as shown in the receipt. However, the producer has a right to special bin storage. This is normally used by a farmer who has at least one carload of rapeseed and wishes to retain identity of it so that it can be shipped forward intact and sold on the basis of the grade given when the car is officially sampled and graded at a terminal elevator. Also, if the producer and agent disagree on the grade of a particular lot of rapeseed, it may be stored in a special bin. The producer can take redelivery of his own seed if it is stored in a special bin.

In western Canada, there are approximately four thousand country elevators, owned by farmers' co-operatives and private companies. The older elevators were originally constructed to hold from twenty to thirty thousand bushels, but today most are built with space for over one hundred thousand bushels. The total capacity of elevators and their annexes is approximately 365 million bushels. Private and government elevators in larger centers bring the total prairie storage capacity to more than 645 million bushels.

Country elevators have anywhere from twenty to forty storage bins, or even more. Many of these are equipped with rapeseed cleaning equipment and dust collecting systems. The elevators levy a charge on the producer for receiving, storing and shipping his rapeseed.

The government interior terminals which provide a physical facility for producers, grain companies and exporters, represent a potential source of substantial storage and handling capacity, but their utilization is discouraged by the extra costs of handling. The government elevators at Edmonton and Saskatoon are licensed to operate in part as country elevators in handling rapessed, by performing the same functions as commerical country elevators. The elevators in Edmonton, Calgary, and Saskatoon are all designated as delivery points for rapeseed futures and, in this capacity, they play an important part in the futures market's operation.

Where rapeseed is transferred from rail to water trans-

port, or from lake vessels to boxcars or ocean-going ships, large terminal elevators have been built. These are primarily designed to unload boxcars or vessels efficiently, to provide safe storage and to move the rapeseed promptly to foreign markets. Cars arriving at the elevators are unloaded either by means of power shovels or by the use of a car dumper and most of the seed is cleaned before it is put away in the storage bins.

5. Provision and Dissemination of Information and Research

This marketing function is not so well developed as the others discussed, nor is it easily distinguished from them. Much of the research and information on the rapeseed market is provided by the government, as a subsidized input to the producer and in the interests of marketing efficiency. Information and research is basically an input to the other functions.

The country elevator operator is an important source of information for the producer. He may supply market information on features such as rapeseed prices, quotas, and availability of boxcars. The local District Agriculturists inform the producers of new varieties, fertilizer usage, et cetera.

Statistics related to the handling and storage of rapeseed within the Canadian elevator system are published on a regular basis by the Statistics Division of the Board of Grain Commissioners. Operations of the Board and detailed

analysis of elevator handlings are also prepared. This division also provides statistical services for the Canadian Wheat Board and Statistics Canada.

The research laboratory of the Board of Grain Commissioners analyzes problems relating to the effects of the degrading factors on the quality of rapeseed. The laboratory distributes information on the quality of current crops and on standard and standard export samples and provides records on the quality of all grades of Canadian rapeseed shipped and in store. It also takes part in the production and testing of new varieties, and researches rapeseed quality and ways of measuring it.

Generally speaking, the government assumes responsibility for the research portion of this function through the Department of Agriculture, and leaves the dissemination of information to elevator companies and various organizations such as the Rapeseed Association of Canada, the National Farmer's Union, and Unifarm.

The latter part of this chapter has been a survey of the operational aspects of the Canadian rapeseed market. That is, price discovery, standardization and grading, transportation, storage, and the provision and dissemination of information and research have been reviewed. Chapter IV further discusses that segment of the market which discovers and determines prices. Chapter V evaluates pricing performance in the rapeseed market, being concerned with the market value of rapeseed realized by the producer and with inter-

temporal price relationships within the rapeseed futures market.

CHAPTER III

REVIEW OF LITERATURE

This chapter concerns itself with an outline of and a review of literature relevant to two widely accepted theories on inter-temporal price relationships in a futures market. An inter-temporal price relationship is a relationship at a given time between prices applicable to different times. For example, this term may include the relationship at a given time between the spot price and a forward price for the same commodity, or may refer to the relationship between two forward prices, such as the relationship between prices of the March and June rapeseed futures.

These two theories are the "Theory of Normal Backwardation" and the "Theory of the Price of Storage", advanced by John Maynard Keynes and Holbrook Working, respectively.

The Theory of Normal Backwardation

An essay in the Manchester Guardian Commercial[1] in 1923 by John Maynard Keynes initiated the concept of the "Theory of Normal Backwardation". He later expanded the

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[1] J.M. Keynes, "Some Aspects of Commodity Markets", Manchester Guardian Commercial, March, 1923, pp. 784-6.

theory as follows:

> If supply and demand are balanced, the spot price must exceed the forward price by the amount which the producer is ready to sacrifice in order to "hedge" himself, i.e., to avoid the risk of price fluctuations during his production period. Thus in normal conditions the spot price exceeds the forward price, i.e., there is backwardation. In other words, the normal supply price on the spot includes remuneration for the risk of price fluctuations during the period of production, whilst the forward price excludes this. The statistics of organized markets show that 10 percent per annum is a modest estimate of the amount of this backwardation in the case of seasonal crops which have a production period approaching a year in length and are exposed to all the chances of weather. In less organized markets the cost is much higher.[2]

For illustration purposes one can say that Keynes hypothesized the October price of a January futures contract is not a reliable estimate of the forthcoming "spot" price in January but is less than the expected spot price. This theory, in effect, argues that speculators sell "insurance" to hedgers. In order to insure themselves against the risk of a price change, hedgers take offsetting positions in the spot and futures market. Speculators must buy more contracts than they sell because hedgers usually sell more than they buy. In the proper terminology, hedgers are generally net short[3] and speculators net long,[4] therefore the futures

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[2] J.M. Keynes, Treatise on Money, Vol. II (New York: Harcourt Publishers, 1930), p. 143.

[3] Being net short signifies that, on the average, hedgers sell more contracts than they buy.

[4] Being net long signifies that, on the average, speculators buy more contracts than they sell.

price is below the expected spot price and the risk premium paid to speculators equals this difference.

Two major implications can be assigned to the theory of normal backwardation. The first is that, on the average, long speculators should receive profits and short hedgers should suffer losses[5] on their futures transactions. That is, over time, speculators would earn profits by merely holding long positions in futures markets.

The second implication, which is tested in Chapter V, is that there should be an upward trend in futures prices, relative to spot prices, as the contract approaches maturity. The theory postulates that the futures price is below the expected spot price by the amount of the insurance premium paid the long speculators by the short hedgers. This insurance premium is an increasing function of the length of time between the maturity date of the futures contract and the current date, assuming it is more difficult to foresee a price change the more distant the future. Since the insurance premium is the difference between the expected spot price and the futures price, it will decrease as the futures contract approaches maturity. Therefore, the theory of normal backwardation implies that the price of a futures contract tends to rise relative to the expected spot price as the contract approaches maturity.

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[5] Any profits received, in aggregate, by speculators are paid by hedgers since all profits must be exactly offset by losses in a futures market.

Review of Theoretical Literature

In "Value and Capital", J.R. Hicks supported the contention of Keynes:

> But it is of the essence of speculation, as opposed to hedging, that the speculator puts himself into a more risky position as a result of his forward trading - he need not have ventured into forward dealing at all, and would have been safer if he had not done so. He will therefore only be willing to go on buying futures so long as the futures price remains definitely below the spot price he expects; for it is the difference between these prices which he can expect to receive as a return for his risk-bearing, and it would not be worth his while to undertake the risk if the prospective return is too small.
>
> Mr. Keynes has pointed out the consequences of this in an important passage of his "Treatise on Money". In "normal" conditions, when demand and supply conditions are expected to remain unchanged, and therefore the spot price is expected to be about the same in a month's time as it is today, the futures price for one month's delivery is bound to be below the spot price now ruling. The difference between these two prices (the current spot price and the currently fixed futures price) is called by Mr. Keynes "normal backwardation". It measures the amount which hedgers have to hand over to speculators in order to persuade the speculators to take over the risks of the price-fluctuations in question.[6]

The bulk of later theoretical reasoning which considered the Keynes-Hicks theory of normal backwardation was put forward by Nicholas Kaldor,[7] J.C.R. Dow,[8]

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[6] J.R. Hicks, Value and Capital, (2nd ed.; Oxford: Claredon Press, 1946), p. 138.

[7] N. Kaldor, "Speculation and Economic Stability", Review of Economic Studies, Vol. III (1939-40), pp. 1-27.

[8] J.C.R. Dow, "A Theoretical Account of Futures Market", Review of Economic Studies, Vol. III (1939-40), pp. 185-195.

R.G. Hawtrey,[9] and Gerda Blau.[10] With the exception of Hawtrey, these writers supported the Keynes-Hicks hypothesis. Kaldor questioned only the magnitude of the bias. Dow added the concept of "negative" as well as "positive" risks to the theory. Blau refined and formalized the previous concepts of normal backwardation. The only one to question the logic of the risk premium, Hawtrey, foreshadowed the "price of storage" theory which was to be expanded later by Holbrook Working.

The Theory of the Price of Storage

Possibly the most important critique of the Keynes-Hicks hypothesis of "normal backwardation" was that presented by H. Working.[11] In his view, inter-temporal price relationships are determined by the "cost" of carrying stocks. For example, he hypothesized that in the presence of abundant supplies the price for January delivery tends to be the price for October delivery plus the cost of storing rapeseed from October to January.

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[9] R.G. Hawtrey, "A Symposium on the Theory of the Futures Market", Review of Economic Studies, Vol. VII (1939-40), pp. 196-205.

[10] G. Blau, "Some Aspects of the Theory of Futures Trading", Review of Economic Studies, Vol. XII (1944-45), pp. 1-30.

[11] H. Working, "Theory of the Price of Storage", American Economic Review, Vol. XXXIX, No. 6 (1949), pp. 150-66.

Working argued that the price of storage gives hedgers an approximate index of the return to be expected from storing the commodity. He pointed out that the return could be either positive or negative, depending on the size of the stocks to be carried. The expected return would not, therefore, necessarily have to represent the physical costs associated with the storage of the commodity.

A very important conclusion can be drawn from Working's contention that the costs of storing or holding the actual commodity rise directly with time. As the futures price is the cash price plus storage costs according to this theory, it follows that the price of a futures contract tends to decrease relative to the spot price as the contract approaches maturity. This conclusion is in direct conflict with the contention of Keynes and Hicks that futures prices increase relative to the cash or spot price over time.

Review of Statistical Literature

One of the first studies to compile price statistics with the aim of measuring the degree of normal backwardation or "risk-premium" as it came to be called, was done by the United States Federal Trade Commission in their Report on the Grain Trade.[12] Working summarized the findings of this report as follows:

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[12] U.S. Federal Trade Commission, Report on the Grain Trade (Washington, D.C.: U.S Federal Trade Commission, 1920-26).

> Contrary to Keynes' apparent assumption it is not a simple matter, as we shall see, to determine precisely what "the statistics of organized markets show" with respect to the price tendency he was considering. One of the most critical and painstaking inquiries into the subject was that made by the Federal Trade Commission. It attacked the problem in several different ways. All the methods produced evidence, in price data subsequent to 1896, of some "downward bias" in futures prices of wheat and corn, but not of oats; but for the ten-year period prior to 1896, the indicated bias was in the opposite direction for all grains. The method which the Federal Trade Commission appeared to regard as quantitatively most trustworthy, and the only one from which it drew a value which it discussed as a measure of bias, yielded for wheat, 1906-16, the estimate that it amounted to -2.39 cents (about 2.4 percent) for a twelve-month interval.[13]

Houthakker[14] found that speculators as a whole earned profits on cotton and wheat futures and he attempted to separate those profits attributable to forecasting skills from those attributable to a risk premium. In a later study[15] he quantified the extent of bias in the cotton and corn futures markets in the United States for a period of approximately twenty years in each case. Houthakker's conclusions were as follows:

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[13] H. Working, "Theory of the Inverse Carrying Charge in Futures Markets", Journal of Farm Economics, Vol. XXX, No. 1 (1948), p. 9.

[14] H.S. Houthakker, "Can Speculators Forecast Prices?", Review of Economics and Statistics, Vol. XXXIX, No. 2 (May, 1959).

[15] H.S. Houthakker, "Commodity Futures IV: An Empirical Test of the Theory of Normal Backwardation" (Cowles Commission Discussion Paper; Economics No. 2124, June 22, 1955).

> In his original discussion Keynes gave as a "modest estimate" of the rate of backwardation for commodities such as cotton and corn a figure of 10 percent per annum. Apart from a vague reference to the "statistics of organized markets" Keynes produced no evidence for this estimate, but it now appears to have been remarkably shrewd. Since the average spot prices over the periods here considered were 20.87 cents per pound for cotton and 106.4 cents per bushel for corn, our results indicate an annual rate of backwardation of 7.8 percent per annum for cotton and 8.6 percent per annum for corn.[16]

A study by Telser[17] challenged Houthakker's findings. He found no evidence of a risk premium in the New York cotton and Chicago wheat futures markets. That is, he found no consistent difference between the futures price and the spot price expected upon expiration of a contract. Tesler believed that competitive speculation bid the risk premium to zero as indicated by the following excerpt from his conclusions:

> Next the relation between the expected price and the futures price was analyzed. A widely accepted theory advanced by Keynes and Hicks which relates the futures price and the expected spot price regards hedgers as buyers of insurance and speculators as sellers of insurance who must be induced to bear the risk of price changes. When statistical evidence was examined to see whether futures prices display an upward trend as they approach maturity predicted by this theory, it was found instead that futures prices display no trend. Although hedgers may be willing to pay speculators to bear the risks of price changes, they need not do so if speculators are eager to speculate. Firms that hedge can reduce their price risks

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[16] Ibid., pp. 14-15.

[17] L.G. Telser, "Futures Trading and the Storage of Cotton and Wheat", Journal of Political Economy, LXVI, No. 3 (June, 1958), pp. 233-55.

at little or no cost to themselves. I accepted the hypothesis that the futures price equals the expected spot price.[18]

A study by Brennan[19] gave evidence of a reasonably large risk premium. He concluded: "The estimated returns per annum are as follows: wheat 6.6 percent, oats 6.8 percent, butter 7.9 percent, eggs 8.5 percent and cheese 9.5 percent."[20]

Paul Cootner[21] challenged the conclusions of Telser and went on to support the Keynes-Hicks hypothesis. His results led him to state: "The basic elements in the Keynesian hypothesis, with which I agree, are that the opportunity to hedge is a valuable service furnished by speculators in the expectation of a financial return and that return is indeed earned."[22]

Gray's[23] findings contradicted those of Houthakker,

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[18] Ibid., p. 253.

[19] M.J. Brennan, "The Supply of Storage", American Economic Review, Vol. XLVIII, No. 1 (March, 1958), pp. 50-72.

[20] Ibid., p. 67.

[21] P.H. Cootner, "Returns to Speculators: Tesler versus Keynes", Journal of Political Economy, Vol. VIII, No. 4 (August, 1960), pp. 396-404.

[22] Ibid., p. 398.

[23] R.W. Gray, "The Search for a Risk Premium", Journal of Political Economy, Vol. LXIX, No. 3 (June, 1961), pp. 250-60.

Brennan, and Cootner. However, he did find what he termed a "characteristic bias" in some thinly traded futures markets, but sought to explain these in terms other than those associated with risk.

A recent Canadian study, by L. Martin and G. Storey,[24] found enough evidence in the Vancouver rapeseed futures market to allow them to support the Keynes-Hicks theory of normal backwardation. A discussion of their methodology and their results will follow in Chapter V.

In summarizing the literature reviewed, it becomes apparent that to date neither of the two theories of intertemporal price relationships has been fully accepted or rejected. However, in a world characterized by numerous storable commodities traded in numerous futures markets, it is conceivable that Working's theory may apply in one case and Keynes' theory in another. Chapter V, which follows, attempts to determine if the theory of Keynes applies in the case of the Winnipeg rapeseed futures market.

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[24] L. Martin and G. Storey, "Temporal Price Relationships in the Vancouver Rapeseed Futures Market and Their Implications to Farm Prices", Canadian Journal of Agricultural Economics, Vol. 23, No. 3 (November, 1975), pp. 1-12.

CHAPTER IV

THE PRICE FORMATION PROCESS FOR RAPESEED

The Futures Market

Chapter V, which follows, evaluates pricing performance in the Canadian rapeseed market. That topic requires cognizance of the theoretical basis of a futures market and with this in mind this chapter presents a brief description of futures markets in general. It then describes the contract for Winnipeg rapeseed futures and details the formation of rapeseed street prices in western Canada.

The futures market deals with promises to deliver or receive a commodity at some stated time in the future. Each new purchase and sale represents the creation of a new, legally binding contract to transfer a given amount of the actual commodity in question. Futures contracts are bought and sold on organized exchanges. The contracts always specify the quantity and quality of the product to be delivered and the place and time at which it will be delivered. The exchange does not set prices but merely facilitates trading and records the prices at which trades are made each day between openly bidding buyers and sellers.

There are two broad classifications of participants in futures markets. These are hedgers and speculators.

Hedgers are people who are interested in dealing in futures contracts for the purpose of avoiding risk of loss by price changes. Speculators are those interested in dealing in futures contracts for the purpose of making financial gain as the prices of futures rise and fall. They accept this price risk in the expectation of making profits.

The Commodity Futures Market

Futures markets tended to develop historically in response to both commercial and speculative demand. Those who owned commodities at any stage from production to consumption have frequently entered into forward contracts (the actual sale of a commodity for delivery at a specific time in the future) in order to protect themselves against adverse price movements. Subsequently, the contracts came to be traded by individuals who wished to profit from price fluctuations in the commodities but who did not necessarily desire delivery.

Organized commodity exchanges were developed to provide a suitable marketplace where buyers and sellers could conduct their business, "...a place to meet, to establish principles in the trade, to supply useful information, to regulate standards of contracts, and to maintain uniform rules and regulations."[1] The exchanges do not buy or sell,

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[1] Richardson Securities of Canada, Commodity Futures, p. 4.

handle, transport or process commodities. They do not set prices, they merely provide the facilities whereby the price is evolved and recorded.

Commodity exchanges attempt to ensure the integrity of futures markets. They set contract specifications and ensure that these are met. Further, they specify all conditions under which trading must be conducted, including specific trading hours and maximum daily price fluctuations for a given commodity.

The public participates in the trading by entering orders with a member firm. A person can buy or sell a contract for any of the designated delivery months currently being traded on an exchange. Buying a contract is referred to as taking a long position, and selling a contract is termed taking a short position. Both contracts may be liquidated prior to the delivery month by the establishment of an offsetting transaction. That is, the buyer of a contract would normally later sell a contract, and the seller of a contract would buy a contract. The trader's profit or loss is realized in the difference between the price at which he initiated his contract and the price at which he liquidated it. Only two or three percent of all futures contracts are settled by delivery of the commodity, the rest are offset prior to the delivery month.

All commodity exchanges maintain a clearing house. Each day after the close of the market, each firm hands to the clearing house lists of all its purchases and sales with

the name of the person or firm for whom they made these trades. The clearing house becomes the other party to all the trades. Once this phase is completed the buyers and sellers deal directly with the clearing house (regarding specific contracts) and not with each other.

For operation of an effective futures market, certain conditions should exist.[2] The market should be competitive in the production and distribution of the commodity so that no individual or group can control prices or markets. The commodity should be available from a large number of producers and should be subject to standard grading. Also, there should be participation by the leading members of the industries involved to supply the volume of trading needed for a liquid market.

The Contract for Winnipeg Rapeseed Futures

The standard rapeseed contract is 5,000 bushels although trade is also carried on in job lots of 1,000 bushels or multiples of this. Deliverable grades are one and two Canada rapeseed although delivery is permitted of superior or inferior grades at fixed premiums or discounts.

The futures market for Canadian rapeseed began in September, 1963 on the Winnipeg Grain Exchange. Trading in rapeseed futures was confined to the months of November,

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[2] Richardson Securities of Canada, Commodity Futures, p. 3.

January, March, May and July for Vancouver delivery until 1971 when Vancouver delivery began to be traded for the months of January, March, June, September and November. Thunder Bay delivery was added in 1971 for the trading months of May, July, October, November and December.

Deliveries of Thunder Bay rapeseed are made by delivering warehouse receipts in even 1,000 bushel lots or multiples of this against stocks in registered terminals at Thunder Bay. Upon delivery the seller does not have to indicate any notice of intent but simply directs a delivery notice to the Clearing House between the hours of 9:50 a.m. and 11:50 a.m. and the buyer picks up the invoice and upon payment of this obtains the warehouse receipt from the clearing firm of the seller. The buyer is obliged to accept delivery on the business day of the delivery month chosen by the seller and he must make payment during banking hours on the same day.

For Vancouver delivery, the exchange specifies that: "Deliveries of Vancouver rapeseed must be in store a licensed semi-public Terminal Elevator on Tidewater at Vancouver, B.C., or any alternate delivery point.

An alternate delivery point shall be in store government terminals at Calgary, Edmonton or Saskatoon in which case the seller must:

1. Deliver interior warehouse receipts in quantities of not less than 1,000 bushels or multiples thereof not later than ten calendar days prior to the last trading day of the delivery month in question.

2. Assume all additional cost and expenses (not including storage beyond allowable free period) from "in store" interior government terminals to "in store" Vancouver terminal.

3. Assume freight costs from the alternate delivery point to "in store" Vancouver as specified and provide buyer with railway receipts indicating freight prepaid to Vancouver.[3]

Street Price for Rapeseed

The price which western producers receive for their rapeseed, and other non-Board grains, is generally termed the street or broadcast price. The street price has been established by a committee in Calgary for deliveries in Alberta and for deliveries in Manitoba and Saskatchewan, a committee in Winnipeg.[4]

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[3] Richardson Securities of Canada, Commodity Futures, pp. 26-27.

[4] The arrangement by which street prices for non-Board grains are currently arrived at is to be disbanded within two to three months time. Currently, street price committees establish daily broadcast prices, based on the price of the nearest futures month during which the grain could be delivered. However, the determination of street prices after the disbandment of the committees will remain much the same as it is now. The Alberta Grain Commissioner, Mr. John Channon, commented in a personal communication that under the tentative new arrangement the Winnipeg Commodity Exchange will broadcast daily the futures price on which to base the street price, along with the marketing charges required to get the grain into a deliverable position. With this information, the producer can deduct the marketing charges from the futures price and make adjustment to the price for his local station freight rates in order to give himself an indication of the minimum price he should expect to receive for non-Board grain deliveries to his local county elevator.

Since the arrangement for the determination of street prices is about to be changed, the past tense is used for the remainder of the text when referring to the present (March, 1976) system of street price determination.

These Quotation Committees met daily after the close of the Winnipeg Commodity Exchange, to set the daily street price.

The Committees used the price of a nearby futures contract as a basis for determining the street price. Generally the nearest futures month has been used provided that it was not closer than six to nine weeks away.[5]

> The appropriate futures month to use when pricing is largely determined by the time which is required to get the grain in position in a terminal elevator. Deductions are made from the futures price to cover the costs attached to physically handling the grain (elevation), freight to the terminal on dockage contained in the grain, cleaning the grain, invisible shrinkage, administration, weighing and inspection fees payable to the Canadian Grain Commission, and to freight on the grain from a delivery point having a selected freight rate either to Thunder Bay or Vancouver. Storage and interest charges expected to be incurred during the period required to place the grain in salable position in the terminals are also deducted. Credit is given where applicable for the anticipated return on the screenings carried in the grain. The deductions and the credit constitute the "net charges" or the amount by which the futures price is discounted in arriving at the "street" price. The "net charges" change frequently since the costs attached to many of the individual items contributing to the charges vary over time and according to market conditions. Premiums may on occasion effectively reduce the "net charges".[6]

Table 4.1 shows an example of one day's guideline charges used by the Alberta Quotations Committee in arriving

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[5] Country Elevators Association, Information Sheet on Non-Board Street Quotations, May, 1975.

[6] Canada Grains Council, Canadian Grains Industry Statistical Handbook 1974, (Winnipeg: Canada Grains Council, 1974), p. 144.

TABLE 4.1

ALBERTA NON-BOARD QUOTATIONS (FOR THE PURPOSE OF ILLUSTRATION, EARLY IN MAY OF 1975, THE FOLLOWING "GUIDELINE" CHARGES WERE BEING CONSIDERED BY THE ALBERTA QUOTATIONS COMMITTEE IN ARRIVING AT A BROADCAST PRICE)

Charges	Non-Board Grains					
	Flax	Rye	Rapeseed	Wheat	Oats	Barley
	¢ per bushel					
Elevation	9.0	9.0	9.0	8.75	7.0	8.75
Freight on Dockage	1.5	.5	1.5	--	--	--
Cleaning	4.5	.5	4.5	--	--	--
Administration	1.0	1.0	1.0	1.0	1.0	1.0
Weighing & Inspection	.375	.375	.375	.375	.375	.375
Freight	17.75	16.75	16.0	25.75	14.75	20.75
Fixed Charges, Sub-Total	34.125¢	28.125¢	32.375¢	35.875¢	23.125¢	30.875¢
Storage	3.00	3.00	3.00	3.00	3.00	3.00
Interest	21.00	6.00	15.00	9.00	4.50	6.00
Variable Charges, Sub-Total	24.00¢	9.00¢	18.00¢	12.00¢	7.50¢	9.00¢
Less Return for Screenings	3.00	.50	2.00	--	--	--
Net Charges	55.125¢	36.625¢	48.375¢	47.875¢	30.625¢	39.875¢

SOURCE: Country Elevators Association, Information Sheet on Non-Board Street Quotations, May, 1975.

NOTE: The above charges can vary from time to time depending upon variable conditions such as changes in market condition, grain values, bank interest rates, and transportation facilities.

at a broadcast price. Deductions from a futures month used for a non-Board broadcast price have changed from day to day. An illustration of the variation of discounts under futures months is given in Table 4.2 where the difference between the broadcast street price and the futures price is recorded for three recent dates. It must be noted that the broadcast street prices for rapeseed were not necessarily buying prices for any one particular elevator company. The broadcast price released each trading day by the Quotations Committee was essentially its interpretation of current grain values at the country elevator and was made available primarily for the information of producers.

Broadcast prices for rapeseed in Alberta were announced on a Schedule from 1 to 6 with Schedule 1 indicating the broadcast price was based on Thunder Bay futures values and requiring the guideline charges to include freight charges to the Thunder Bay terminals. Schedule 6 indicated the broadcast price was based on Vancouver futures values and required an adjustment basis Vancouver freights. The intermediate schedules, 2 to 5, were used to lessen the impact of a switch in one day from Schedule 1 to 6 or vice versa. In Manitoba and Saskatchewan, Schedule A represented deliveries to Thunder Bay and Schedule B deliveries to Vancouver.

TABLE 4.2

FUTURES AND BROADCAST PRICE FOR THREE SELECTED DATES IN CENTS PER BUSHEL

	Rapeseed
January 28, 1976	
(a) Futures Price	508¢
(b) Broadcast Price	444¢
(c) Difference	64¢
February 4, 1976	
(a) Futures Price	512½
(b) Broadcast Price	466
(c) Difference	46½
February 11, 1976	
(a) Futures Price	508½¢
(b) Broadcast Price	446½¢
(c) Difference	62¢

SOURCE: The Edmonton Journal.

NOTE: The Broadcast Prices presented are Alberta street prices. The futures prices are prices of March futures calling for Vancouver delivery.

CHAPTER V

AN EMPIRICAL TEST OF THE THEORY OF NORMAL BACKWARDATION IN THE WINNIPEG RAPESEED FUTURES MARKET

A Previous Study

Two Canadian agricultural economists, Martin and Storey,[1] found that Vancouver rapeseed futures prices were persistently downward biased in estimating the forthcoming spot price from October, 1963 to January, 1973. They employed Gray's[2] approach of testing the implication of the theory of "normal backwardation": that a speculator should, on the average, expect to earn a profit by following a strategy of purchasing futures contracts before maturity and selling them on the initial delivery day of the month of their maturity. Gray had statistically tested the resulting aggregate profits and losses to determine if, on the average, a profit was made. Table 5.1 displays Martin and

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[1] L. Martin and G. Storey, "Temporal Price Relationships in the Vancouver Rapeseed Futures Market and Their Implications to Farm Prices", Canadian Journal of Agricultural Economics, Vol. 23, No. 3 (November, 1975), pp. 1-11.

[2] R.W. Gray, "The Characteristic Bias in Some Thin Futures Markets", Food Research Institute Studies, I, No. 3, Stanford University, 1960.

TABLE 5.1

EXPECTED PROFIT PER BUSHEL FROM LONG SPECULATIVE POSITIONS TAKEN TWO, THREE, FOUR AND FIVE MONTHS BEFORE CONTRACT MATURITY, VANCOUVER RAPESEED, OCTOBER, 1963 - JANUARY, 1973

	Length of Long Open Position			
	Two Months	Three Months	Four Months	Five Months
Average profit per bu. for transaction completed first week of delivery month	5¢	9¢	11¢	14¢
t-value	(1.67)	(2.15)	(2.28)	(2.58)
Average profit per bu. for transaction completed week before delivery month	6¢	9¢	11¢	14¢
t-value	(2.04)	(2.52)	(2.65)	(2.89)
average profit per bu. for transaction completed two weeks before delivery month	7¢	10¢	13¢	16¢
t-value	(2.59)	(2.78)	(2.87)	(3.06)

SOURCE: L. Martin and G. Storey, "Temporal Price Relationships in the Vancouver Rapeseed Futures Market and Their Implications to Farm Prices", Canadian Journal of Agricultural Economics, Vol. 23, No. 3 (November, 1975), p. 7.

Storey's results which indicate a price bias in the Vancouver market ranging from five to sixteen cents per bushel, depending on the length of the long open position the speculator is assumed to hold.

In their study, Martin and Storey note two major reasons for the existence of a price bias in the Canadian rapeseed futures market. The first is that there is a relatively small volume of speculative trading in rapeseed futures. That is, one expects that when there is a shortage of long speculators in the market, short hedgers must offer a risk premium to induce speculators to take a long position. The second reason given for the bias is related to physical problems in the market. Problems such as bottlenecks in the transportation and storage of rapeseed result in frequent shortages of the oilseed available for export, and consequently grain merchants with sales commitments may bid up the price of nearby futures contracts with the intention of taking delivery.

As pointed out by Martin and Storey, a downward bias in futures prices has important implications to producer prices for rapeseed. The method of establishing producer street prices in western Canada by deducting marketing costs from a futures price was outlined in Chapter IV. It can be inferred from the method by which street prices are arrived at, that if the futures price on which the street price is based is biased downward by x percent, then x percent is also effectively deducted in the determination of the street

price.

Having acknowledged this implication, Martin and Storey's study leaves ample room for further research on the existence of a price bias in the Winnipeg rapeseed futures market. In this chapter it is planned to extend the Martin and Storey analysis because of the importance of the impact a price bias may have on producer prices. This study attempts the use of a more explicit test in measuring for any price bias. This study also attempts to provide a more detailed breakdown of the extent of the bias believed to exist. The current study covers two more years than was the case with Martin and Storey's and includes rapeseed futures contracts calling for Thunder Bay delivery as well as for Vancouver delivery.

The methodology utilized by Martin and Storey does not give an accurate measurement of a price bias in the Winnipeg rapeseed futures market. An accurate measurement for any price bias (that might reflect a risk premium) must gauge futures price changes over a long period of time, adjusted for any change in spot prices. Martin and Storey do not measure changes in futures prices net of any changes in spot price levels. Without correcting futures price changes for changes in spot prices, one cannot entirely attribute speculator's profits to a risk premium since any portion of such profits may be adduced to forecasting skills. That is, if cash prices rise and carry futures prices with them, a speculator may gain, but only because he forecasted a price

rise. Table 2.1 is evidence of the fact that rapeseed cash prices were not stable during the 1963 to 1973 period studied by Martin and Storey. Therefore, their results which were presented in Table 5.1 cannot be taken as correct estimates of a price bias which may reflect a risk premium.

To reiterate, because of the implication of a price bias to producer prices made known by Martin and Storey, the statistical analysis in this chapter attempts to determine whether or not the rapeseed futures prices on the Winnipeg Grain exchange are downward biased. A price bias can be measured by testing the major implication of the theory of "normal backwardation": that there is an upward trend in the futures price relative to the spot price as the contract approaches maturity.

The Model and Data Collection

The methodology used follows the approach used by H.S. Houthakker[3] in analyzing cotton and corn futures in the United States.

As formulated by Keynes the theory of "normal backwardation" does not assume that the futures price must rise in absolute terms for the spot price does not remain constant over time but shifts continually for a variety of

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[3] H.S. Houthakker, "Commodity Futures IV: An Empirical Test of the Theory of Normal Backwardation" (Cowles Commission Discussion Paper; Economics No. 2124, June 22, 1955).

reasons. Therefore a test of the validity of the theory must measure any change in the futures price adjusted for any change in the spot price, as the contract approaches maturity.

Denoting the spot price by "s", the futures price by "f", the rate of change per month of "f" with respect to time when the spot price is held constant by "a", and changes by Δ, the theory of "normal backwardation" can be expressed as:

$$\Delta f = a + b\Delta s \qquad (5.1)$$

where the theory of "normal backwardation" postulates that "a" is positive. Theoretically, the measurement of any change in the futures price as maturity approaches should be in relation to the speculative equilibrium price of the contract. This is the price at which long and short speculators' commitments just offset each other. However, since the speculative equilibrium price is not observable it is linked to the spot price under the assumption that the two variables change proportionately. For this reason, $b\Delta s$ is used as a proxy for changes in the speculative equilibrium price, in the formulation of equation 5.1

Equation 5.1 is the specification of the model to which data on Canadian rapeseed is fitted. The technique used is ordinary least squares. It is assumed that "f" is the dependent and "s" the independent variable.

Futures prices data were obtained from the computer bank of the Department of Rural Economy at the University of Alberta, and are reported in the Toronto Globe and Mail. The spot prices used were Winnipeg Commodity Exchange monthly average cash grain prices for No. 1 Canada rapeseed. These prices were available basis in store Vancouver from October, 1963 to September, 1970; thereafter the series was basis in store Thunder Bay (from September, 1970 to April, 1975). These spot prices were published by Statistics Canada.[4]

Empirical Results and Analysis

The results of the empirical analysis are presented in Tables 5.2 to 5.10. In Tables 5.2 to 5.9, each of the columns refers to a particular futures contract and each row refers to a month of quotation.[5] To leave the order of maturity unchanged, some contracts appear in two columns in Tables 5.2 to 5.9. All estimates of "a" in Tables 5.6 to 5.9 are expressed in dollars per bushel.

The coefficients of determination between the first differences of each futures price and the first differences of each spot price are presented in Tables 5.2 to 5.5. This information is useful in evaluating whether the futures

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[4] Statistics Canada, Coarse Grains Review, Cat. No. 22-001 (Ottawa: DBS, 1963-1975).

[5] Since first differences were used each reference to "January", for instance, means the change in January from the preceding December.

market is an effective risk reducing mechanism for hedgers since to the extent that spot and futures prices move in parallel fashion, the hedger can reduce risks associated with price fluctuations. Therefore, if risk reduction is a major objective of hedgers, the usefulness to them of futures markets depends on the degree of correlation that exists between movements in cash prices and movements in futures prices. In the parlance of futures markets, the differences between cash and futures prices is termed the "basis", and a situation of relative stability of the "basis" is associated with risk reduction. Therefore, the higher the coefficients of determination estimated, the more attractive both long and short hedging become.

Tables 5.2 to 5.5 present the values of R^2 in four separate tables in order to divorce those contracts traded for different time periods and for different delivery points from one another. Tables 5.2 to 5.4 present the values of R^2 for the three different time periods Vancouver delivery contracts have been traded. Table 5.5 presents the values of R^2 for Thunder Bay contracts traded from 1971 to 1975.

The R^2 values in Tables 5.2 to 5.5 represent the degree of variation in futures prices ("f") that can be explained by the degree of variation in spot prices ("s"). With some exceptions (which apply in more instances for Vancouver than for Thunder Bay delivery) the magnitude of the estimates of the coefficients of determination (R^2) tend to diminish along each row from left to right in Tables 5.2 to 5.5. This

TABLE 5.2

RAPESEED (VANCOUVER DELIVERY 1963-75) CORRELATION BETWEEN CHANGES IN SPOT PRICE AND IN FUTURES PRICE (VALUES OF R^2)

Month of Quotation	Maturity Date of Futures Contract					All Futures Combined
	January	March	November	January[d]	March[d]	
January	.9158	.9304[a]				
February		.6154				
March		.6615	.1253			
April			.7521			
May			.9378	.1117		
June			.8992	.8534		
July			.9280	.8647	.1000	
August			.5316	.5926	.5921	
September			.9280	.8740	.8082	
October			.9540	.7069	.9511	
November			.5695	.5920	.4452	
December				.8374	.2900	
Total	.7334[b]	.5604	.7968			.6865[c]

[a] An interpretation of this estimate of R^2 suggests that 93.04 percent of the changes in the price of a March futures contract from the month of December to the month of January tend to be explained by changes in spot prices from the month of December to the month of January.

[b] An interpretation of this estimate of R^2 suggests that 73.34 percent of changes in the futures price of a January futures contract tends to be explained by changes in spot prices.

[c] An interpretation of this estimate of R^2 suggests that for the combination of all Vancouver delivery futures contracts traded from 1963 to 1975, 68.65 percent of the variation in their futures prices tends to be explained by the variation in spot prices over the same period.

[d] To leave the order of maturity unchanged, some contracts appear in two columns.

TABLE 5.3

RAPESEED (VANCOUVER DELIVERY 1963-71) CORRELATION BETWEEN CHANGES IN SPOT PRICE AND IN FUTURES PRICE (VALUES OF R^2)

	Maturity Date of Futures Contracts			
Quotation	May	July	May	Both Futures Combined
January	.7115	.6748		
February	.1165	.0271		
March	.4886	.2005		
April	.4368	.0115		
May	.9640	.6907		
June		.7666		
July		.5225		
August				
September			.9388	
October			.9352	
November			.5180	
December			.6930	
Total	.6447	.4134		.3629

TABLE 5.4

RAPESEED (VANCOUVER DELIVERY 1971-75) CORRELATION BETWEEN CHANGES IN SPOT PRICE AND IN FUTURES PRICE (VALUES OF R^2)

Month of Quotation	Maturity Date of Futures Contract			Both Futures Combined
	June	September	June	
January	.9727			
February	.6603			
March	.8105	.5741		
April	.9195	.9172		
May	.9287	.9376		
June	.7935	.9930		
July		.9207		
August		.8012		
September		.9196		
October				
November			.9776	
December			.9873	
Total	.7361	.8531		.7818

TABLE 5.5

RAPESEED (THUNDER BAY DELIVERY 1971-75) CORRELATION BETWEEN CHANGES IN SPOT PRICE AND IN FUTURES PRICE (VALUES OF R^2)

	Maturity Date of Futures Contract							
Quotation	May	July	October	November	December	May	July	All Futures Combined
January	.9812	.9989						
February	.8188	.6115	.8633					
March	.1994	.4766	.2634					
April	.9947	.9541	.9472	.0038				
May	.9994	.9974	.9983	.8661				
June		.9067	.9257	.9059	.9932			
July		1.0000	.9015	.8964	.9656			
August			.8302	.6509	.6788			
September			.9992	.9762	.9749	.9491		
October			.9924	.9990	.8578	.9988		
November				.3374	.8273	.7747		
December					.9984	.9870	.6978	
Total	.5206	.7068	.7235	.8117	.6327			.7214

suggests that for each month of quotation, the changes in the spot price tend to be more closely associated with changes in the near futures price than with changes in the more distant futures price.

As noted on page 62, the degree of correlation between spot and futures prices is one of the factors which reflect the effectiveness of hedging. Provided other determining factors remain constant, both long and short hedgers should tend to prefer the November Thunder Bay and September and November Vancouver contracts since these contracts display the highest value of R^2 for the entire life of any contract. However, January and June contracts for Vancouver delivery and July and October contracts for Thunder Bay delivery also show a respectable degree of correspondence between changes in futures prices and changes in spot prices, that is, for the entire life of each of these four contracts more than seventy percent of the variation in the futures price is explained by the variation in the spot price. It appears that neither the March Vancouver nor the May Thunder Bay contract would be desirable futures contracts on which to base a hedge because of the low R^2 values which are estimated for them.

To repeat, hedgers should tend to prefer those futures contracts which display the highest value of R^2, provided other determining factors remain constant. Other determining factors include the remaining life of the contract and the magnitude of the "basis" (the difference between the spot

price and the futures price).

Estimates of the intercept term from equation 5.1 and the standard errors associated with these estimates are presented in Tables 5.6 to 5.9. Tables 5.6 to 5.8 present the estimates for the three different time periods Vancouver delivery contracts have been traded. Table 5.9 presents the estimates for the single time period over which Thunder Bay contracts have been traded. From equation 5.1 ($\Delta f = a + b\Delta s$), the intercept "a" represents "Δf" when "s" is held constant. That is, the intercept term indicates the rate of change per month of a futures price with respect to time when the spot price is held constant. Keynes has postulated that an estimate of the intercept term should be greater than zero. The standard error associated with each "a" indicates the dispersion of each estimate of the intercept term. The larger the standard errors relative to the estimates associated with them, the lower the reliability of the estimate.

There is much variation among the estimates of the intercept term for both Vancouver and Thunder Bay delivery contracts. This feature does not contradict the Keynesian theory of "normal backwardation" since the theory refers to the whole life of the contract. With a few exceptions, the negative estimates of "a" are on the whole smaller than the positive estimates of "a". That is, the absolute value of the positive estimates tend to be larger than the absolute value of the negative estimates, resulting in a positive estimate of the intercept term for the duration of the entire

TABLE 5.6

RAPESEED (VANCOUVER DELIVERY 1963-75) ESTIMATE AND STANDARD ERROR OF "a" IN DOLLARS PER BUSHEL

	Maturity Date of Futures Contract					All Futures Combined
Quotation	January	March	November	January	March	
January	-.00662 (.00180)	-.00939 (.13969)				
February		-.02455 (.00587)				
March		.01474 (.00162)	.02601[a] (.00332)			
April			-.04614 (.00199)			
May			.07101 (.00067)	.04834 (.01024)		
June			-.01017 (.00230)	-.02433 (.00540)		
July			.09518 (.00170)	.14008 (.00311)	.03967 (.00143)	

[a] An interpretation of this estimate of "a" suggests that the rate of change of the price of a November futures contract from the month of February to the month of March is .02601 dollars per bushel over the period considered, when the spot price is held constant. The standard error associated with this estimate is .00332.

TABLE 5.6 (CONTINUED)

Month of Quotation	Maturity Date of Futures Contract					All Futures Combined
	January	March	November	January	March	
August			.22068 (.00864)	.19746 (.00823)	.00000 (.00027)	
September			-.02165 (.00010)	.02054 (.00221)	-.07513 (.00326)	
October			.03218 (.00076)	.01248 (.00070)	.02893 (.00038)	
November			.06499 (.00187)	.09555 (.00066)	.06506 (.00068)	
December				.03346 (.00193)	.07713 (.00040)	
Total	.06106[b] (.00039)	.00307 (.00040)	.04793 (.00029)			.03659[c] (.00013)

[b] An interpretation of this estimate of "a" suggests that the January futures contract calling for Vancouver delivery and traded from 1963 to 1975 tends to display a downward price bias of the order of .06106 dollars per bushel per month.

[c] An interpretation of this estimate of "a" suggests that the January, March, and November futures contracts combined as one tend to display a downward price bias of the order of .03659 dollars per bushel per month.

TABLE 5.7

RAPESEED (VANCOUVER DELIVERY 1963-71) ESTIMATE AND STANDARD ERROR OF "a" IN DOLLARS PER BUSHEL

Month of Quotation	Maturity Date of Futures Contracts			Both Futures Combined
	May	July	May	
January	.00366 (.00035)	.05549 (.00070)		
February	.03193 (.00106)	.01037 (.00105)		
March	-.01261 (.00107)	-.02916 (.00266)		
April	-.00662 (.00069)	-.00732 (.00152)		
May	.00539 (.00009)	.10182 (.00198)		
June		-.01488 (.00020)		
July		.12964 (.00605)		
August				
September			.02449 (.00023)	
October			-.03555 (.00026)	
November			.07236 (.00225)	
December			.08654 (.00062)	
Total	.00958 (.00009)	.02455 (.00037)		.01471 (.00009)

TABLE 5.8

RAPESEED (VANCOUVER DELIVERY 1971-75) ESTIMATE AND STANDARD ERROR OF "a" IN DOLLARS PER BUSHEL

Month of Quotation	Maturity Date of Futures Contract			Both Futures Combined
	June	September		
January	-.03051 (.00017)			
February	-.13647 (.02818)			
March	-.03962 (.00204)	.00642 (.00496)		
April	-.08478 (.00137)	-.00781 (.00190)		
May	.10082 (.00480)	.02182 (.00397)		
June	.19964 (.04661)	.02583 (.00130)		
July		-.03245 (.02600)		
August		.29334 (.02718)		
September		-.07790 (.00822)		
October				
November			.02350 (.00012)	
December			.04116 (.00086)	
Total	.02039 (.00175)	.03754 (.00163)		.02875 (.00091)

TABLE 5.9

RAPESEED (THUNDER BAY DELIVERY 1971-75) ESTIMATE AND STANDARD ERROR OF "a" IN DOLLARS PER BUSHEL

Month of Quotation	Maturity Date of Futures Contract							All Futures Combined
	May	July	October	November	December	May	July	
January	-.06000 (.00272)	-.19130 (.00023)						
February	-.20405 (.02717)	-.02463 (.02045)	-.21442 (.09127)					
March	-.01734 (.01175)	-.09775 (.02338)	-.11188 (.06077)					
April	-.09088 (.00075)	-.00071 (.00324)	-.01966 (.00192)	.18837 (.00073)				
May	.01424 (.00014)	-.04589 (.00031)	-.47890 (.00004)	-.06360 (.00693)				
June		.16892 (.04271)	-.07397) (.01643)	-.09031 (.04274)	-.00075 (.00268)			

TABLE 5.9 (CONTINUED)

Month of Quotation	Maturity Date of Futures Contracts							All Futures Combined
	May	July	October	November	December	May	July	
July		-.01059 (.00000)	.01957 (.02384)	.15674 (.05270)	.11575 (.00669)			
August			.35238 (.01996)	.33963 (.06473)	.41635 (.05325)			
September			-.01774 (.00001)	.00089 (.00612)	-.03936 (.00246)	-.03569 (.00270)		
October			-.03276 (.00094)	.10239 (.00031)	.15445 (.01335)	.02357 (.00006)		
November				-.09621 (.01146)	.07125 (.00152)	.01408 (.00095)		
December					-.00398 (.00022)	.07506 (.00163)	.41894 (.09259)	
Total	-.00163 (.00155)	.02548 (.00441)	.01059 (.00253)	.08857 (.00297)	.13106 (.00489)			.04566 (.00062)

contract. So even though the estimates of "a" may be negative for various months of quotation, the estimate of "a" for the entire life of each contract studied tends to be positive and in agreement with the Keynesian theory of "normal backwardation".

A test of the Keynesian "normal backwardation" theory is provided by the estimates of the values of "a" for the duration of each contract, given in the bottom row of Tables 5.6 to 5.9. This is the row labelled "total" in each table. For contracts involving Vancouver delivery, all seven of the estimates of "a" are positive. Employing the t-test statistic one can be 99% confident that the estimates are significantly different from zero. Four out of five of the estimates of "a" are positive for Thunder Bay delivery and again, the high t values associated with each positive estimate indicate that these are significantly different from zero. The negative estimate of "a" for the May Thunder Bay contract is not significantly different from zero, since the relatively high standard error associated with it results in a low t value for the estimate.

Estimates of "a" for all futures combined within each Table are given in the bottom right hand corner of Tables 5.6 to 5.9. These estimates of the intercept term are arrived at by fitting all of the spot and futures prices data associated with all of the contracts in each respective Table to the model equation 5.1. For example, the estimate of "a" found at the intersection of the last row and last

column in Table 5.6 is determined by combining the spot and futures prices data of the January, March and November contracts and fitting this to the model using ordinary least squares procedure. This estimate suggests that the "average" Vancouver rapeseed futures contract traded from 1963 to 1975 increased on the average by .03659 dollars per bushel per month in addition to the effect of changes in the spot price. In other words, the "average" Vancouver rapeseed futures contract traded from 1963 to 1975 tends to display a degree of "normal backwardation" of the order of .03659 dollars per bushel per month. The "average" Vancouver contract traded from 1963 to 1971 displayed a degree of "normal backwardation" of the magnitude of .01471 dollars per bushel per month (refer to the bottom right hand corner of Table 5.7). From Table 5.8, the degree of "normal backwardation" displayed by the "average" Vancouver contract traded from 1971 to 1975 tends to be .02875 dollars per bushel per month. Table 5.9 displays a degree of "normal backwardation" of .04566 dollars per bushel per month for an "average" Thunder Bay contract traded from 1971 to 1975. The standard errors associated with each of these estimates are relatively small in relation to the magnitude of the estimate of the intercept. The estimates tend, therefore, to be significiantly different from zero if the t-test is employed.

The results of a conversion of the estimates of "a" presented in the bottom row of Tables 5.5 to 5.9, into an annual percentage of the spot price of rapeseed are given in

Table 5.10. This conversion is made in order to permit a comparison of the estimates of the rate of "normal backwardation" for the Winnipeg rapeseed futures market with the rate of backwardation suggested by Keynes in the Treatise on Money. For the first step in the conversion, each estimate of "a" from the bottom of Tables 5.5 to 5.9 was multiplied by twelve in order to render the estimates from monthly into annual rates. After multiplication the estimate is then converted into a percentage of the average spot price prevailing at the time. The results given in Table 5.10 are determined by assuming an average spot price of $2.61309 per bushel of rapeseed for the 1963-71 period, $4.46071 per bushel for the 1971-75 period and $3.35214 for the 1963-75 period. These averages are based on prices published by Statistics Canada.[6] In Table 5.10 the first nine rows refer to particular futures contracts and the last three rows refer to combinations of contracts traded during similar time periods. Each of the two columns refer to the delivery points of Vancouver and Thunder Bay respectively.

In the Treatise on Money Keynes gave as a "modest estimate" of the rate of backwardation for commodities in general a figure of 10 percent per annum. Out of the twelve estimates for individual contracts presented in Table 5.10, November and December contracts for Thunder Bay delivery

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[6] Statistics Canada, Coarse Grain Review, Cat. No. 22-001 (Ottawa: DBS, 1963-1975).

TABLE 5.10

RATE OF BACKWARDATION OF RAPESEED CONTRACTS FOR VANCOUVER AND THUNDER BAY DELIVERY (PERCENT PER ANNUM)

Month of Maturity	Delivery Point	
	Vancouver	Thunder Bay
January	21.86[a]	
March	1.10	
May	4.40	-0.44
June	5.48	
July	11.27	6.85
September	10.10	
October		2.85
November	17.16	23.82
December		35.26
1963-75 (Combined)	13.10	
1963-71 (Combined)	6.75	
1971-75 (Combined)	7.73	12.28[b]

[a] An interpretation of this estimate of the rate of backwardation suggests that the price of a January futures contract calling for Vancouver delivery tends to increase over the life of the contract by a rate of 21.86% per annum.

[b] An interpretation of this estimate of the rate of backwardation suggests that the price of all Thunder Bay contracts traded from 1971 to 1975 combined tends to increase at a rate of 12.28 percent per annum. That is, the price of an "average" Thunder Bay contract is downward biased by a rate of 12.28 percent per annum.

and November and January contracts for Vancouver delivery are somewhat higher than Keynes' general estimate. July and September contracts for Vancouver delivery are close to Keynes' estimate. Of the remaining six estimates of the rate of backwardation, with the exception of that of the May Thunder Bay contract, it can be concluded that they exhibit some positive degree of backwardation.

Generalizing the results presented in Table 5.10, it can be concluded that they are in general agreement with the theory of "normal backwardation", that is, they provide evidence of a downward price bias in the Winnipeg rapeseed futures market. The variation of the estimates of the degree of backwardation among the various contracts is a feature which provides useful information for the discussion of the implications of the characteristic price bias.

Implication of Results to Street Prices

The main implication of the observed price bias in the Winnipeg rapeseed futures market to producer street prices is straightforward. Since the rapeseed futures prices tend to be biased downward, the prices received by producers are also biased downward to the extent that they are a reflection of the futures price. That is, to the extent that futures prices are used as a mechanism for determining producer prices, any downward biased futures price results in a downward biased producer price. Producer street prices based on the futures months presented in Table 5.10 would

tend to be biased downward to approximately the same extent that the futures contract on which they are based is biased downward. For example, from Table 5.10, a producer street price based on the January futures contract for Vancouver delivery would tend to be biased downward by 5.46 percent if it was determined near the beginning of November. That is, if the price of a January Vancouver contract is downward biased by a rate of 21.86 percent per annum on the average then a broadcast price based on that contract three months before its maturity would tend to be downward biased by 5.46 percent on the average. Now, suppose this producer street price, determined by the street pricing committee near the beginning of November was $4.50 per bushel, based on the January futures contract trading at $5.00 per bushel. If the price of a January futures contract is biased downward by 5.46 percent in November it will therefore tend to rise from $5.00 to $5.28 by the time it matures. Instead of deducting marketing charges of $.50 from the $5.00 November trading price of a January Vancouver contract, the street pricing committee should have deducted the $.50 charge from the $5.28 which the contract will tend to rise to. In effect, in this example, the producer street price should have been $4.78 instead of $4.50. That is, the producer street price is downward biased by 5.85 percent. The producer is "losing" $28.00 for every 1,000 bushels of rapeseed he sells for $4.50 near the beginning of November because in this example the pricing committee did not correct the pro-

ducer street price for the downward biased futures price on which it was based. Applying the logic of the above example, a similar argument can be prepared for the implication of the observed price bias in the other rapeseed futures contracts, shown in Table 5.10, to producer prices.

The question arises as to whether or not the degree of price bias evident in the Winnipeg rapeseed futures market can be entirely attributed to the risk premium which hedgers are believed to pay to speculators. In considering the question, one must note that the existence of any price bias is a necessary but not a sufficient condition to establish the existence of a risk premium. Other possible causes of a price bias are a lack of adequate speculation and transportation and storage bottlenecks which result in market squeezes.[7]

It is interesting to note from Table 5.10 that the degree of price bias tends to be highest for those contracts which mature immediately after harvest. These are the November, December and January contracts. This feature suggests that there is an element of a risk premium included in the observed price bias. Recall, the notion of a risk premium is generally associated with speculators selling

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[7] A market squeeze is characterized by a sharp upward movement in the price of a futures contract near maturity, due to an excess of demand over supply. A squeeze is commonly caused by a shortage of rapeseed in a deliverable position to fulfill contract obligations and a concurrent inability to move more rapeseed into a deliverable position by the time the contract matures.

insurance to hedgers. The return which speculators receive for their services is highest at the point in time when net short hedging increases due to abundant stocks. Net short hedging most likely tends to be the heaviest on the November, December and January contracts. Therefore it appears that hedgers are paying a substantial risk premium for the privilege of taking a short position in these three contracts. This feature of the risk premium apparently tending to increase when stocks are abundant and when net short hedging increases is supported by a statement of Keynes.

> The additional element of uncertainty introduced by the existence of stocks and the additional supply of risk-bearing which they require mean that he (the producer) must pay more than usual. In other words, the quoted forward price, though above the present spot price, must fall below the anticipated future spot price by at least the amount of normal backwardation; and the present spot price, since it is lower than the quoted forward price, must be much lower than the anticipated future spot price.[8]

The observed price bias is likely composed of the three factors mentioned; they are, a lack of speculative activity on rapeseed futures, transportation and storage problems which result in market squeezes, and the existence of a risk premium. The separation of the influence which each factor has on the price bias proves difficult as no data are available on trader's positions in Canadian futures markets. However, the inability to separate the influences does not detract from the importance of the implications of the price

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[8] J.M. Keynes, Treatise on Money, Vol. II (New York: Harcourt, 1930), p. 144.

bias to Canadian rapeseed producers.

The example on page 81 of the implication of the observed price bias to producer street prices leads one to conclude that the Quotations Committees in Calgary and Winnipeg have not been correctly interpreting the inter-temporal price relationships on the rapeseed market in determining rapeseed street prices. Currently, the street price is established by deducting storage costs from a distant futures contract price which does not only reflect a storage charge but also reflects a countervailing price bias. That is, the theory of "normal backwardation" cannot be viewed as being mutually exclusive with the theory of the "price of storage" in regard to the Winnipeg rapeseed futures market. In determining street prices, the Quotation Committees should deduct storage and other marketing costs from an unbiased distant futures price. In other words, in arriving at street prices, before deducting marketing costs from the price of a futures contract, they should add to the price of a futures contract the amount by which it is downward biased.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and Recommendations

The analytical results presented in Chapter V provide evidence of a downward price bias in the Winnipeg rapeseed futures market. That is, they indicate that the futures price is a downward biased estimate of the expected spot price. Subject to one reservation, the results are in general agreement with the theory of "normal backwardation". The reservation is that the existence of a price bias is a necessary but not a sufficient condition to establish the existence of a risk premium. In other words, the magnitude of the observed price bias cannot be entirely attributed to the concept of a risk premium. Therefore, this study can only conclude that the results indicate the existence of a price bias which is likely caused by the presence of a risk premium, a lack of adequate speculation, and transportation and storage bottlenecks.

The results obtained for both Vancouver and Thunder Bay contracts are sufficiently similar to be summarized together. All seven of the Vancouver rapeseed futures contracts shown in Table 5.10 display a price bias. The price biases displayed by the various Vancouver contracts range

from 1.1 to 21.86 percent per annum. Four of the five Thunder Bay contracts display a price bias ranging from 2.85 to 35.86 percent per annum. The degree of price bias tends to be the largest for those contracts that are likely subject to the greatest amount of (short) hedging pressure during times of abundant stocks. These are the futures contracts which mature immediately succeeding the harvest. On the average, Thunder Bay contracts traded from 1971 to 1975 were downward biased by 12.28 percent per annum. The prices of Vancouver rapeseed futures contracts that were traded from 1963 to 1971 tended to be downward biased by a rate of 6.75 percent per annum. Vancouver contracts traded from 1971 to 1975 were biased by 7.73 percent per annum and those traded from 1963 to 1975 by 13.10 percent per annum. It is likely that the different time periods display differing degrees of price bias because different combinations of contracts were traded during different periods. For example, Vancouver contracts traded from 1963 to 1975 display a larger degree of price bias than those traded from 1963 to 1971 or 1971 to 1975 because January, March and November contracts were traded from 1963 to 1975 and the January and November contracts display a very large degree of price bias. The difference in the price bias between Thunder Bay and Vancouver contracts is likely attributable to differences in the intensity of the factors responsible for the bias at the two delivery points. There may be a difference in the risk premium associated with Thunder Bay contracts as opposed

to that associated with Vancouver contracts. In addition, the extent of speculative activity and of storage and transportation problems may vary between the two ports.

In addition to the estimation of the degree of price bias in the Winnipeg rapeseed futures market, information on the correlation between spot and futures prices is presented in Tables 5.2 to 5.5. Both long and short hedging are more attractive the stronger is this correlation. That is, provided other factors affecting the willingness to hedge remain constant, hedgers should tend to prefer to hedge on those contracts with the highest R^2 values shown in Tables 5.2 to 5.5. Of those contracts that are still being traded, the order of preference of contracts for hedgers, from the most to the least desirable, should tend to be: September Vancouver delivery, November Thunder Bay delivery, November Vancouver delivery, June Vancouver delivery, January Vancouver delivery, October Thunder Bay delivery, July Thunder Bay delivery, December Thunder Bay delivery, March Vancouver delivery, and May Thunder Bay delivery. Provided other factors remain constant, the hedger will also tend to prefer to hedge on a closer rather than on a more distant futures month.

Original and legitimate recommendations which would guarantee removal of the price bias are not presented in this study. It is recommended that the Winnipeg Grain Exchange should not abhor the thought of a price bias in the Winnipeg rapeseed futures markets. After all, the con-

cept of a price bias was considered a normal characteristic of commodity futures markets by John Maynard Keynes and logical theoretical reasoning underlay this position. So, rather than dwelling entirely on the problem of trying to rid the market of the price bias, the Exchange should seriously consider the more important problem of properly correcting producer street prices for the bias.

Since producer prices tend to be a reflection of futures prices, the results documenting the extent of the observed price bias have the greatest value to those who establish street prices in western Canada. The street pricing committees, or their possible successor, the Winnipeg Commodity Exchange, should consider graduating producer prices upward to account for the price bias in the rapeseed futures market. By detailing the extent to which each particular rapeseed futures contract traded on the Winnipeg Grain Exchange tends to be downward biased, Table 5.10 provides sufficient information to allow the Exchange to make a reasonable adjustment to street prices. Under the tentative new street pricing arrangement the Winnipeg Commodity Exchange will presumably broadcast daily the futures price on which the street price would be based, along with the marketing charges required to get the grain into a deliverable position. That is, it would broadcast futures prices and marketing charges to be deducted from this to arrive at an estimate of the street price. This study recommends to the Winnipeg Commodity Exchange that, in their daily broad-

casts, they should indicate to the producer and to elevator companies the extent to which the broadcast futures price tends to be an underestimate of the forthcoming spot price. For example, from Table 5.10, when the price of the September Vancouver contract is broadcast then it should also be made known that the expected September spot price tends to be higher than the September futures price by 10.10 percent per annum, or by .84 percent per month. If the producer is basing his expectation of the street price on the September futures price three months in advance of its maturity, he should then adjust the price of the September contract upward by 2.52 percent. This adjustment would tend to give him a better estimate of the forthcoming spot price from which he could proceed to subtract the broadcast marketing charges to arrive at an expected street price. As a better alternative, and to make the system less confusing to the producer, this study recommends that the Winnipeg Commodity Exchange make the proper adjustment to the futures price before it is broadcast. It could then give a daily broadcast of an "adjusted" futures price for purposes of street pricing.

In any case, street prices in western Canada should be adjusted upwards since they are currently being based on downward biased futures prices. This study provides the estimates of the degree of price bias in the Winnipeg rapeseed futures market, on which the street price adjustments could be founded.

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